IEC-625 BUS Interface
PM 3325

Operating Manual

IEC-625

9499 440 23411
821210

S&I
Scientific & Industrial Equipment Division

PHILIPS

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IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

NOTE: *The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.*

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1. INTRODUCTION

This interface is a General Purpose Bus Line Interface according to the IEC - 625 document by which the oscilloscope can be adapted to make communication possible with other measuring instruments. This under the control of an IEC - bus controller.

This interface enables the oscilloscope to be readily integrated into multi-device systems using the IEC - 625 / IEEE - 488 Bus (also referred to as GPIB or HPIB).
All devices has to be connected in parallel to the same interface lines. Each device has its own specific address (selected with switches in the instrument) so that a device is only listening or talking after it has received its own specific address.
The addresses are generated by the IEC - bus controller (computer) of the system and are transmitted via the data lines (DIO1 ... 8) of the interface bus.

The IEC - 625 bus can be split up into three functional parts; the data bus, the handshake bus and the management bus.
- The DATA BUS is used to transport messages for the device functions as well as for the interface functions and consists of 8 lines (DIO1 ... 8).
- The HANDSHAKE BUS controls the correct transfer of data bytes.
- The MANAGEMENT BUS is used to manage an orderly flow of information across the interface.

IEC - bus Handling is started on an interrupt signal for the oscilloscope. This interrupt signal (RST 5.5) is generated by the IEC interface via the IEC - bus controller and forces the oscilloscope program to jump to a program part for IEC - bus Handling. During IEC - bus Handling the front panel of the oscilloscope will be switched off competely, except trigger select switches. This is indicated then by the REMOTE lamp on the front panel of the oscilloscope.

For more detailed information about the functioning of the hardware of the interface refer to chapter 6.2.14. of the SERVICE MANUAL of the oscilloscope.

2. SPECIFICATION

2.1. INTERFACE FUNCTION REPERTOIRE

Interface function	Identification	Description
Source handshake	SH1	Complete capability
Acceptor handshake	AH1	Complete capability
Talker function	T6	Basic talker, serial poll, unaddress if MLA
Listener function	L4	Basic listener, unaddress if MTA
Service request	SR1	Complete capability
Remote local	RL2	No local lockout
Device clear	DC1	Complete capability
Device trigger	DT1	Complete capability

2.2. BUS DRIVER SPECIFICATIONS

Type of output : Open collector output

2.3. TIMING SPECIFICATIONS

Timing controller → oscilloscope

Transfer of data bytes (ATN false)		: Transfer of interface messages (ATN true)
Tac	first byte ⩽ 21 ms next bytes 6 ms* approx.	: ⩽ 4 μs + handshake time of the controller
Trd	6 ms* approx.	: ⩽ 4 μs + handshake time of the controller
T1	Controller depending	: Controller depending
T1st	Controller depending	: Controller depending
Tsc	Controller depending	: Controller depending

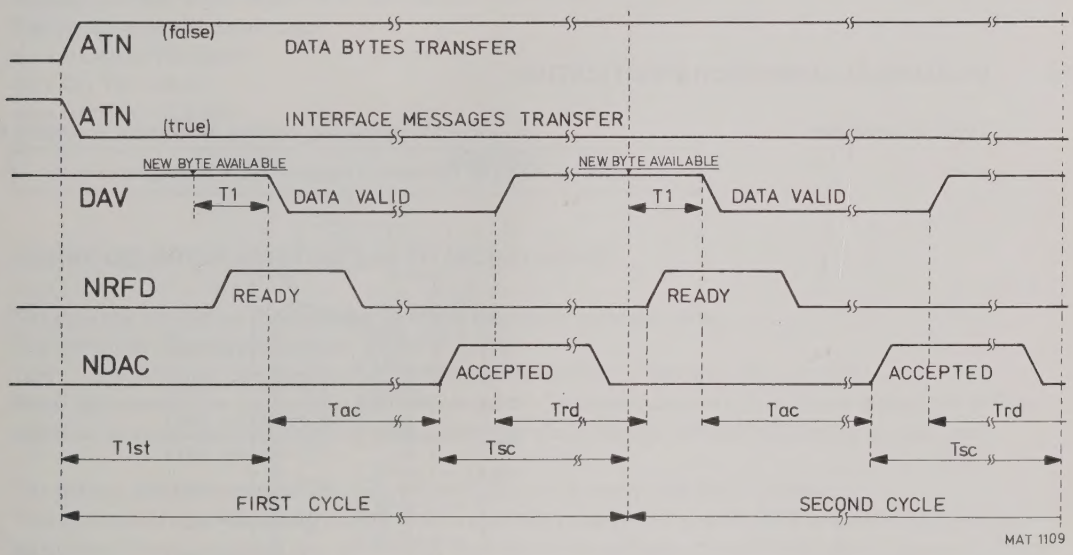
* for controllers capable of sending data bytes with a delay time of < 5 ms worst case. For slow controllers the acceptance time is at least 21 ms/byte.

Timing oscilloscope → controller

Tac	Controller depending
Trd	Controller depending
T1	$\leqslant 30\ \mu s$
T1st	6 ms
Tsc	1 ms approx.

The response time with serial poll until output of status byte: 22 ms maximum.

Tac = Time needed to accept the information byte.
Trd = Time needed until acceptor can receive a new information byte.
T1 = Source data settling time.
T1st = Time needed for the first byte to get available on the bus.
Tsc = Time needed for the next byte to get available on the bus.



2.4. CODE SPECIFICATIONS

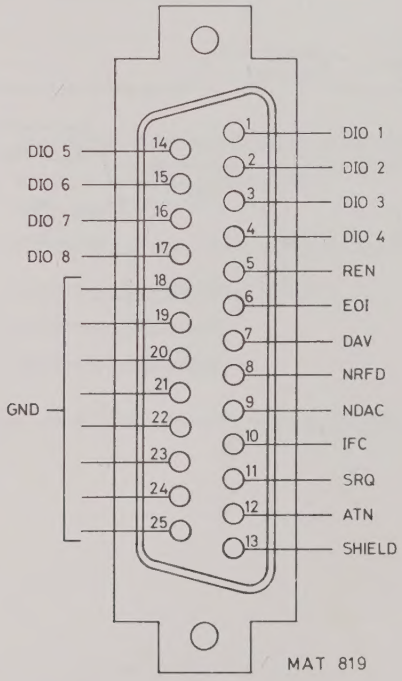
Used code	: ISO - 7 bit code (ISO 646)
Delimiters	: Input delimiter (Controller → oscilloscope) can be any character except: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F and R, K, L, M, N, T and ESC. Output delimiter (oscilloscope → controller) can be defined by the controller. Default value is E T X.
8 DIO lines	: Logic levels: L = 1 (0 V < U < 0.8 V) H = 0 (2 V < U < 5 V)

2.5. ADDRESS SETTING

Device address	: By means of switches the 5 least significant bits of the device address are set.

2.6. MECHANICAL CONNECTOR SPECIFICATION

Type of connector	: 25 - pin male connector, contact assignment according to IEC - 625.



3. PROGRAMMING INFORMATION

For address setting refer to the separate booklet "Installation Instructions" which may be carried out by qualified persons only.

3.0. STARTING UP

When the system is switched-on, the controller must give a SERIAL POLL to make sure that no data bytes are left in the output buffer.

3.1. DESCRIPTION OF ACTIONS

The interface is capable of the following actions:

Define delimiter character and define a delay after every byte.
Frontpanel transfer from oscilloscope to controller
Frontpanel transfer from controller to oscilloscope
Register transfer from oscilloscope to controller
Register transfer from controller to oscilloscope
Call status from the oscilloscope
do a DEVICE TRIGGER
do a GO TO LOCAL
do a DEVICE CLEAR

In all examples, the oscilloscope is assumed to be set to address 8.

3.2. DEFINE DELIMITER (CONTROLLER TO OSCILLOSCOPE)

The operator can define the delimiter to which the oscilloscope will listen.
The controller therefore must send: ESC Ø D D Ø del.
"del" is the delimiter (see specification) which can be filled in by the operator/controller.
From the moment the oscilloscope has interpreted this command sequence, it will only accept the defined delimiter as a message end. The oscilloscope will then also send this defined delimiter as message end.

The default value (after power up from the oscilloscope) is always the ETX character.
This command is therefore very usefull when a controller does not know the ETX as a delimiter: with this instruction it can programm the oscilloscope to listen to the delimiter the controller does know and to send the delimiter the controller does know.

Define wait time

For some controllers it is needed that the time between sending over two groups of data blocks (two bytes + delimiter) can be programmed at a predefined value.
The default value (after power up) is about 1,5 ms (max. speed).
This can be programmed by:

ESC	Ø	D	W	Ø	Ø	del.

A wait time of about 16,5 ms inserted between two blocks of data can be programmed by:

ESC	Ø	D	W	X	X	del.

(XX may be any ASCII characters except 00).

NOTE: It is NOT possible to programm other times than 1,5 ms or 16,5 ms!!

3.3. FRONT PANEL TRANSFER (OSCILLOSCOPE TO CONTROLLER)

The controller asks the oscilloscope for the frontpanel settings by sending:
ESC Ø M T Ø Ø del. See chapter 3.13.1. This delimiter has to be the pre-defined delimiter.

The oscilloscope then answers with 13 times 2 bytes (delimiters after each group of two bytes).
These bytes contain following information:

byte 1&2 : characters M and T (stands for MATRIX TRANSFER)
byte 3&4 : current setting attenuator channel A
byte 5&6 : current mode of channel A
byte 7&8 : current setting attenuator channel B
byte 9&10 : current mode of channel B
byte 11&12 : current setting of the time base
byte 13&14 : current mode of time base
byte 15&16 : selection of the registers displayed and/or inverted
byte 17&18 : display modes (Yx5, Dot Join etc.)
byte 19&20 : register selected for scaling and/or plot and save
byte 21&22 : sign of the trigger delay setting from ACCU
byte 23&24 : most significant two digits of trigger delay setting
byte 25&26 : least significant two digits of trigger delay setting
} from the current setting

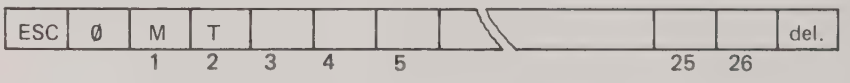
FRONT PANEL TRANSFER (CONTROLLER TO OSCILLOSCOPE)

The operator can program a new 'frontpanel' in the oscilloscope.
This is done by sending: ESC Ø M T and (12 times 2 bytes) + delimiter after the total block of information.

These bytes contain following information:

byte 1&2 : characters M and T
byte 3&4 : new setting of channel A attenuator
byte 5&6 : new mode of channel A
byte 7&8 : new setting of channel B attenuator
byte 9&10 : new mode of channel B
byte 11&12 : new setting of the time base
byte 13&14 : new mode of time base
byte 15&16 : selection of the registers displayed and/or inverted
byte 17&18 : new display modes (YX5, Dot Join etc.)
byte 19&20 : register selected for scaling and/or plot and save
byte 21&22 : new sign of the trigger delay setting from ACCU
byte 23&24 : new most significant two digits of trigger delay setting
byte 25&26 : new least significant two digits of trigger delay setting
} from the current setting

{ The delimiter can be given after byte 14, 20 or 26.
{ Data given after the delimiter will be ignored.



3.4. FRONT PANEL CONVERSION TABLES

3.4.1. Byte 3&4 and 7&8: Attenuator A and B setting

Attenuator setting channel A and channel B	Value of bytes 3 and 7	Value of bytes 4 and 8
10 mV/DIV	D	4
20 mV/DIV	C	4
50 mV/DIV	8	4
.1 V/DIV	8	C
.2 V/DIV	C	C
.5 V/DIV	4	4
1 V/DIV	6	4
2 V/DIV	6	Ø
5 V/DIV	5	Ø
10 V/DIV	D	Ø
20 V/DIV	E	Ø
50 V/DIV	2	4

3.4.2. Byte 11&12: Time Base Setting

Time base setting (recurrent)	Value byte 11	Value byte 12	Time base setting (recurrent)	Time base setting (roll-mode)	Value byte 11	Value byte 12
5 ns	D	4	5 µs	.5 s	D	Ø
10 ns	C	4	10 µs	1 s	E	Ø
20 ns	8	4	20 µs	2 s	2	4
50 ns	8	C	50 µs	5 s	3	C
.1 µs	C	C	.1 ms	10 s	3	8
.2 µs	4	4	.2 ms	20 s	3	Ø
.5 µs	6	4	.5 ms	30 s	7	Ø
1 µs	6	Ø	1 ms	60 s	7	8
2 µs	5	Ø	2 ms	120 s	1	8
			5 ms	360 s	9	8
			10 ms	900 s	8	8
			20 ms	1800 s	Ø	C
			50 ms	3600 s	2	C
			.1 s		A	8
			.2 s		9	Ø

3.4.3. Byte 5 and 9: Mode channels A and B

Value byte 5/9	Channel: calibrated	Channel: uncalibrated	Probe 1 : 1 used	Probe 1 : 10 used
2	YES	NO	NO	YES
3	YES	NO	YES	NO
A	NO	YES	NO	YES
B	NO	YES	YES	NO

CAL and PROBE indication can not be handled by REMOTE control (Byte 5 and byte 9 is then always "Ø").

Byte 6 and 10: Mode of channels A and B

Value byte 6/10	ADD/BINV	Channel ON	Channel ZERO	Channel AC coupled	Channel DC coupled
Ø	YES	YES	YES	YES	NO
1	YES	YES	YES	NO	YES
2	YES	YES	NO	YES	NO
3	YES	YES	NO	NO	YES
8	NO	YES	YES	YES	NO
9	NO	YES	YES	NO	YES
A	NO	YES	NO	YES	NO
B	NO	YES	NO	NO	YES
F	NO	NO	NO	NO	YES

The bytes 6 and 10 are different in one position:
ADD in byte 6 and B-INVERT in byte 10. For the table here listed there is no difference.

3.4.4. Bytes 13 and 14: Time base mode

Value byte 13	Time base mode selected
1	Recurrent mode
2	Multiple mode
4	Single shot
8	Roll mode

Byte 13 prepares the oscilloscope for a certain time-base mode.
If the MULTIPLE (2), SINGLE SHOT (4) or ROLL (8) mode has been selected, the oscilloscope will start the selected measuring mode after a "DEVICE TRIGGER" command has been given (see page 22 chapter 3.8.).
Between the setting and this "DEVICE TRIGGER" command a waiting time might be required, depending on time-base and trigger delay setting.

Byte 14 is the so-called Busy-bit.
It must always be Ø if a setting is send to the oscilloscope.
If the ROLL-mode runs (activated by a "DEVICE TRIGGER" command) it can be stopped by sending the same front panel string (Byte 14 = Ø).

Byte 14 is the so-called busy-bit.
When the message is received from the oscilloscope this byte can have two values. If byte 14 is Ø then the oscilloscope is ready with a measurement, if byte 14 is 8 then the oscilloscope is still busy.

Meaning of the busy-bit for different TIME-BASE modes:

SINGLE	: Busy = "Ø"	The ACCU contents are refreshed once.
	Busy = "1"	The oscilloscope is waiting for a trigger from the input signal or is measuring the input signal.
MULTIPLE	: Busy = "Ø"	The ACCU-ST01-ST02 and ST03 contents are all refreshed once.
	Busy = "1"	The oscilloscope is waiting for a trigger from the input signal or is measuring the input signal.
RECURRENT	: Busy = "Ø"	The oscilloscope is triggered by the input signal.
	Busy = "1"	The oscilloscope is **not** triggered.
ROLL	: Busy = "Ø"	ROLL-mode action is completed.
	Busy = "1"	ROLL-mode action is not yet completed.

The programmer must take into account the duration of the ROLL-mode action for different TIME-BASE settings.

TIME-BASE setting	Time duration ROLL-mode action
0.5 s/div.	20 s
1 s/div.	40 s
2 s/div.	80 s
5 s/div.	200 s
10 s/div.	400 s
20 s/div.	800 s
0.5 min./div.	20 min.
1 min./div.	40 min.
2 min./div.	80 min.
6 min./div.	4 hrs.
15 min./div.	10 hrs.
30 min./div.	20 hrs.
60 min./div.	40 hrs.

3.4.5. Byte 15 and 16: Display and invert registers

Value byte 15	Displayed register:			
	ACCU	ST01	ST02	ST03
F	NO	NO	NO	NO
E	YES	NO	NO	NO
D	NO	YES	NO	NO
C	YES	YES	NO	NO
B	NO	NO	YES	NO
A	YES	NO	YES	NO
9	NO	YES	YES	NO
8	YES	YES	YES	NO
7	NO	NO	NO	YES
6	YES	NO	NO	YES
5	NO	YES	NO	YES
4	YES	YES	NO	YES
3	NO	NO	YES	YES
2	YES	NO	YES	YES
1	NO	YES	YES	YES
Ø	YES	YES	YES	YES

Value byte 16	Inverted register:		
	ST01	ST02	ST03
Ø	YES	YES	YES
2	NO	YES	YES
4	YES	NO	YES
6	NO	NO	YES
8	YES	YES	NO
A	NO	YES	NO
C	YES	NO	NO
E	NO	NO	NO

3.4.6. Bytes 17 and 18: Display mode

Byte 17	Yx1	Yx5	Dots	No dots	X=t	X=A Y=B
Ø	NO	YES	NO	YES	NO	YES
1	NO	YES	NO	YES	YES	NO
2	NO	YES	YES	NO	NO	YES
3	NO	YES	YES	NO	YES	NO
4	YES	NO	NO	YES	NO	YES
5	YES	NO	NO	YES	YES	NO
6	YES	NO	YES	NO	NO	YES
7	YES	NO	YES	NO	YES	NO

Byte 18	Accu clear	Memory lock
Ø	YES	YES
4	YES	NO
8	NO	YES
C	NO	NO

3.4.7. Byte 19 and 20: Register select for scaling/plot and save

Byte 19	Register selected ACCU	ST01	ST02	ST03
1	YES	NO	NO	NO
2	NO	YES	NO	NO
4	NO	NO	YES	NO
8	NO	NO	NO	YES

(for scaling and/or plot)

Byte 20 if plot	Byte 20 no plot	Saved register ST01	ST02	ST03
1	Ø	YES	YES	YES
3	2	NO	YES	YES
5	4	YES	NO	YES
7	6	NO	NO	YES
9	8	YES	YES	NO
B	A	NO	YES	NO
D	C	YES	NO	NO
F	E	NO	NO	NO

A programmed SAVE action can be stopped by sending F or E for byte 20 or by a GO TO LOCAL command.

└── The oscilloscope is not in PLOT-mode.

└── The oscilloscope is or was plotting the memory which was selected before.
(The PLOT action is interrupted by the IEC action.)
Total PLOT time is approx. 100 seconds.

3.4.8. Trigger delay

BYTES 21&22, 23&24 and 25&26: trigger delay part.

These 6 bytes together make the current trigger delay setting of the accumulator.
Byte 21 is Ø if the sign is positive and F for a negative sign.
Byte 22 is Ø if no under or overflow on the settings exists
is C in case of overflow and 3 at underflow.
(Overflow is an attempt to set trigger delay beyond 9999 in direct-mode or to set the trigger delay beyond 100 in sampling-mode.

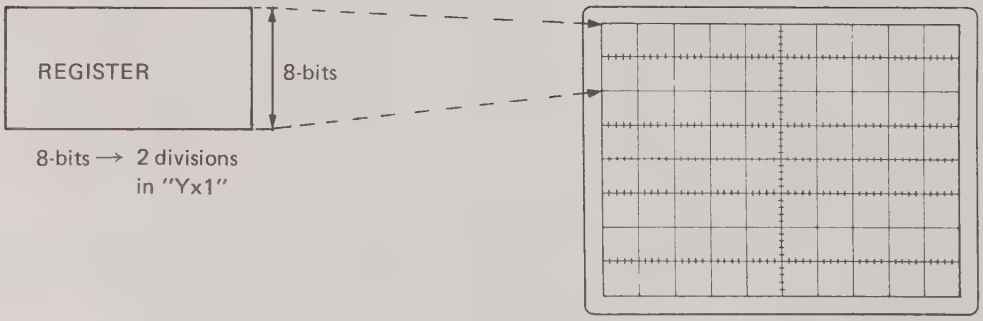
Underflow is an attempt to set trigger delay lower than –9 in direct-mode or lower than Ø in sampling-mode.

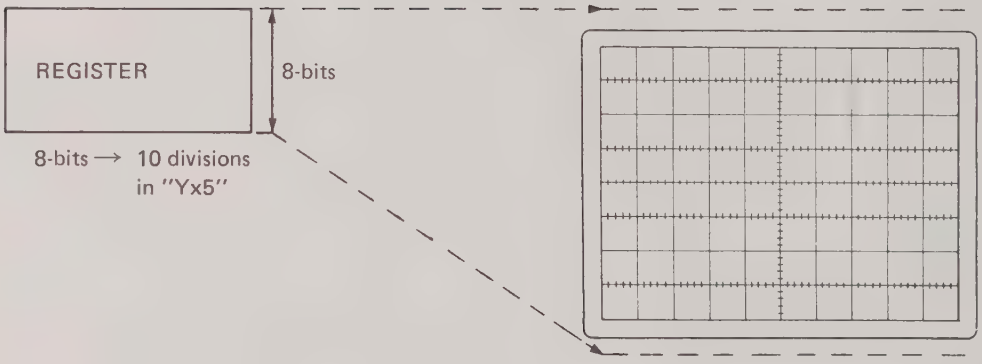
The bytes 23, 24, 25 and 26 contain a decimal.
All together they form the value of the trigger delay setting.
Byte 23 is the most significant digit, byte 26 the least significant one.

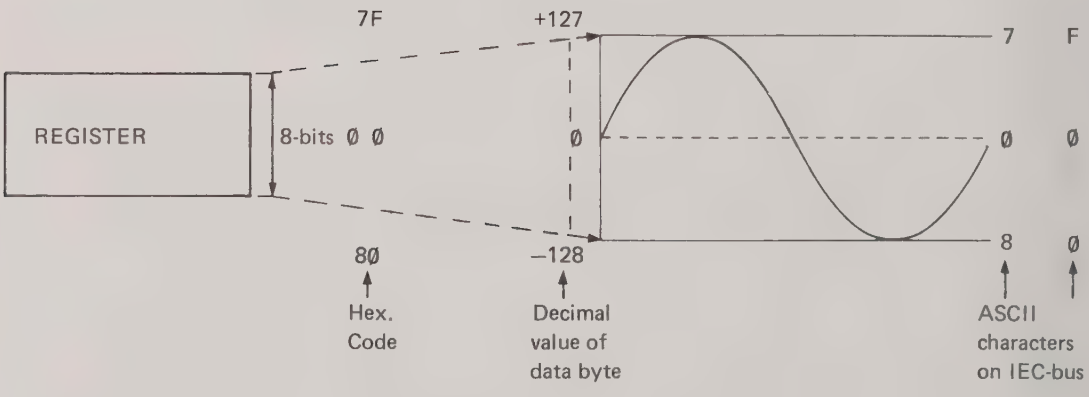
3.5. REGISTER DATA TRANSFER

Register contents VS display:

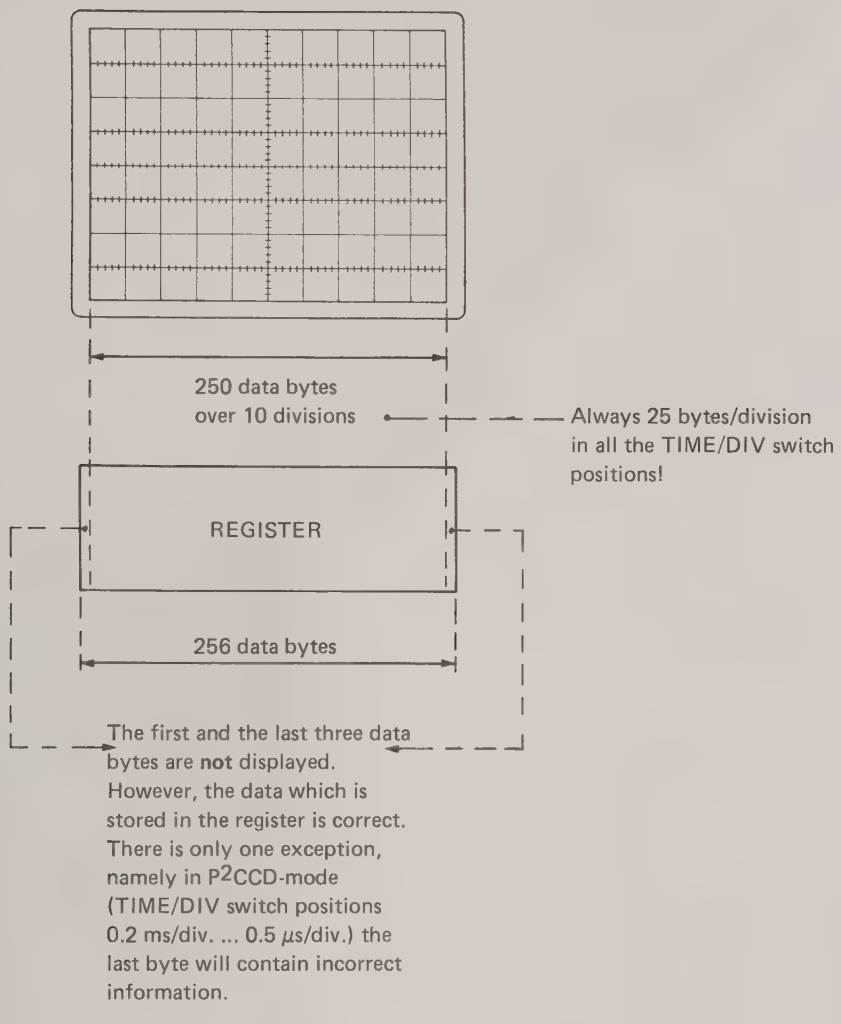
Vertical:







Horizontal:


250 data bytes
over 10 divisions
Always 25 bytes/division
in all the TIME/DIV switch
positions!
REGISTER
256 data bytes
The first and the last three data
bytes are **not** displayed.
However, the data which is
stored in the register is correct.
There is only one exception,
namely in P2CCD-mode
(TIME/DIV switch positions
0.2 ms/div. ... 0.5 µs/div.) the
last byte will contain incorrect
information.

TIME/DIV	FREQUENCY	MODE	TIME BETWEEN TWO SAMPLES
5 ns/div		S	0.2 ns
10 ns/div		S	0.4 ns
20 ns/div		S	0.8 ns
50 ns/div		S	2 ns
0.1 µs/div		S	4 ns
0.2 µs/div		S	8 ns
	TBF		
0.5 µs/div	50 MHz	P	20 ns
1 µs/div	25 MHz	P	40 ns
2 µs/div	12,5 MHz	P	80 ns
5 µs/div	5 MHz	P	200 ns
10 µs/div	2.5 MHz	P	400 ns
20 µs/div	1.25 MHz	P	800 ns
50 µs/div	0.5 MHz	P	2 µs
0.1 ms/div	0.25 MHz	P	4 µs
0.2 ms/div	125 kHz	P	8 µs
	TBS		
0.5 ms/div	50 kHz	D	20 µs
1 ms/div	25 kHz	D	40 µs
2 ms/div	12.5 kHz	D	80 µs
5 ms/div	5 kHz	D	200 µs
10 ms/div	2.5 kHz	D	400 µs
20 ms/div	1.25 kHz	D	800 µs
50 ms/div	500 Hz	D	2 ms
0.1 s/div	250 Hz	D	4 ms
0.2 s/div	125 Hz	D	8 ms
	TBS		
0.5 s/div	50 Hz	R	20 ms
1 s/div	25 Hz	R	40 ms
2 s/div	12.5 Hz	R	80 ms
5 s/div	5 Hz	R	200 ms
10 s/div	2.5 Hz	R	400 ms
20 s/div	1.25 Hz	R	800 ms
30 s/div	5/6 Hz	R	1.2 s
60 s/div	5/12 Hz	R	2.4 s
120 s/div	5/24 Hz	R	4.8 s
360 s/div	5/72 Hz	R	14.4 s
900 s/div	5/180 Hz	R	36 s
1800 s/div	5/360 Hz	R	72 s
3600 s/div	5/720 Hz	R	144 s

NOTE: Only in the P²CCD-mode and SAMPLING-mode the time between two samples as mentioned in the table is **not** *the real time.*

The real sampling time in these modes is much longer because of the principle of these modes.

In P²CCD-mode the time difference is caused by the time conversion principle and in SAMPLING-mode the time difference is caused by inactive triggers which is normal in a sampling system.

3.5.1. REGISTER DATA TRANSFER (OSCILLOSCOPE TO CONTROLLER)

The operator can choose one of the four registers by sending: ESC Ø R X Ø Ø del.
X is: K for ACCU, L for ST01, M for ST02 and N for ST03.

For ACCU selection

ESC	Ø	R	K	Ø	Ø	del.

◄ 1 ► Byte

(The delimiter is normally automatically added by the controller.)

For ST01 selection

ESC	Ø	R	L	Ø	Ø	del.

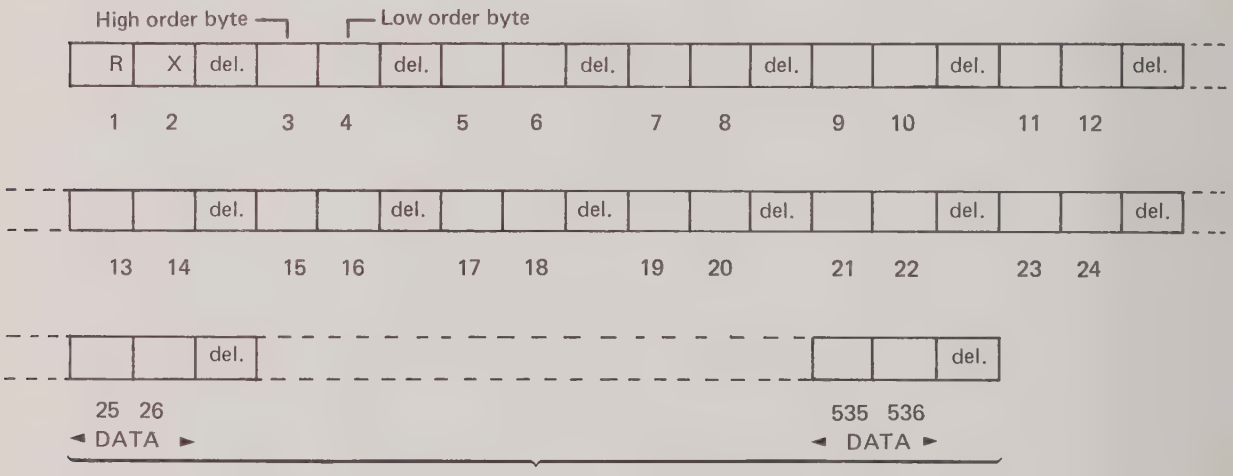
For ST02 selection

ESC	Ø	R	M	Ø	Ø	del.

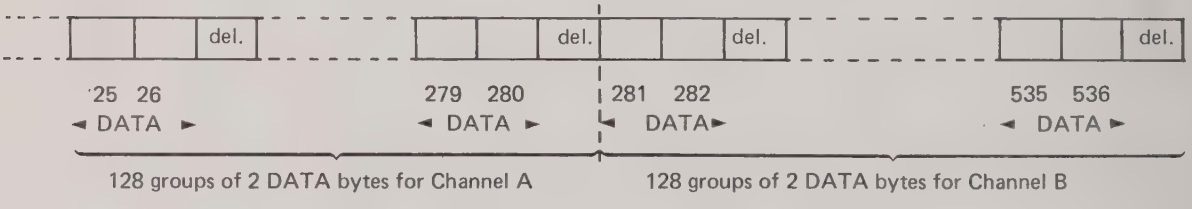
For ST03 selection

ESC	Ø	R	N	Ø	Ø	del.

The oscilloscope then answers by sending 268 groups of two bytes. First the setting (12 groups of two bytes) and then the data (256 groups of two bytes) of the relevant register. Each group of two bytes is terminated by a delimiter.


High order byte
Low order byte
R X del. del. del. del. del. del. del. del.
1 2 3 4 5 6 7 8 9 10 11 12
del. del. del. del. del. del. del. del.
13 14 15 16 17 18 19 20 21 22 23 24
del. del.
25 26
◄ DATA ►
535 536
◄ DATA ►
256 groups of 2 DATA bytes

This was the message format for the vertical display modes "Channel A only", "Channel B only" and "ADD". In dual channel mode the 256 groups of 2 DATA bytes are built up in the following way:



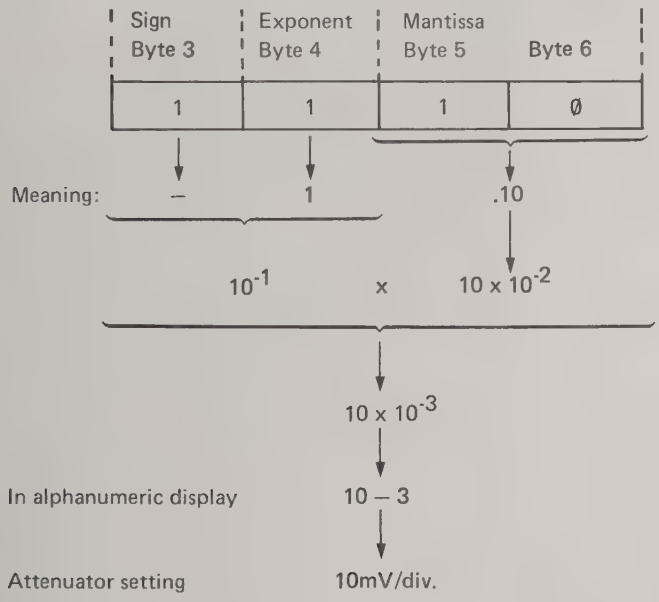
(The maximum byte length inclusive delimiters is 804 bytes.)

The first 24 bytes contain the following data:
byte 1&2 : characters R and X (the selected register)
byte 3&4 : exponent and sign of exponent of channel A setting
byte 5&6 : mantissa of channel A
byte 7&8 : mode of channel A
byte 9&10 : exponent and sign of exponent of channel B setting
byte 11&12 : mantissa of channel B
byte 13&14 : mode of channel B + mode of time base
byte 15&16 : exponent and sign of exponent of time base
byte 17&18 : mantissa of time base
byte 19&20 : sign of trigger delay setting
byte 21&22 : most significant two digits of trigger delay setting
byte 23&24 : least significant two digits of trigger delay setting
The other 256 times 2 bytes contain the signal information.

Generally the settings of channel A, B and the TIME-BASE are in scientific notation.
That is: sign of exponent + exponent + mantissa

1 byte 1 byte 2 bytes

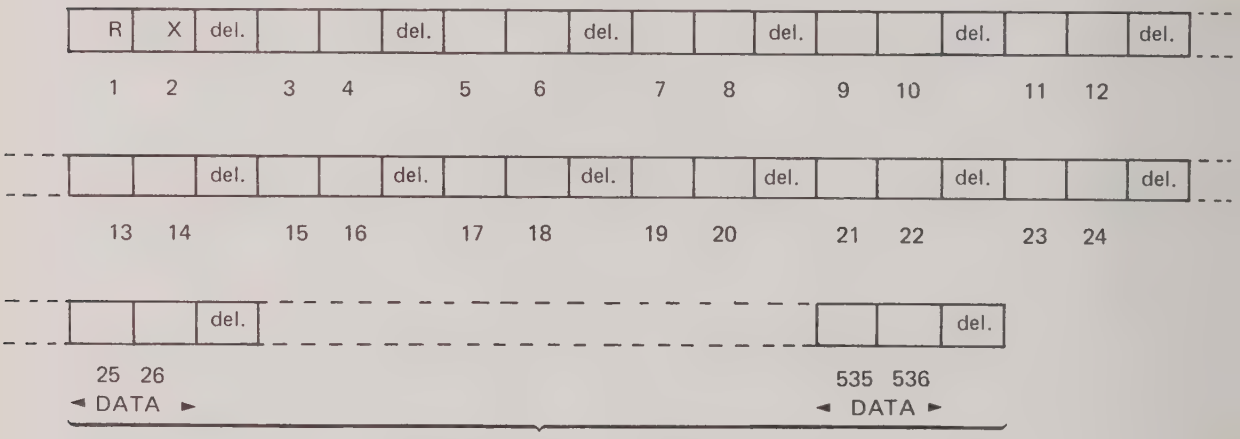
EXAMPLE: Channel A attenuator setting



3.5.2. REGISTER DATA TRANSFER (CONTROLLER TO OSCILLOSCOPE)

The operator can write into one of the four registers by sending: R X and 268 times 2 bytes.
X: is K for ACCU, L for ST01, M for ST02 and N for ST03.
It is not necessary to send a delimiter after each group of two bytes.
Between two delimiters and between start and the first delimiter an even number of bytes must be transferred).

The first 24 bytes contain the following data:
byte 1&2 : characters R and X (the selected register)
byte 3&4 : exponent and sign of exponent of channel A setting
byte 5&6 : mantissa of channel A
byte 7&8 : mode of channel A
byte 9&10 : exponent and sign of exponent of channel B setting
byte 11&12 : mantissa of channel B
byte 13&14 : mode of channel B + mode of time base
byte 15&16 : exponent and sign of exponent of time base
byte 17&18 : mantissa of time base
byte 19&20 : sign of trigger delay setting
byte 21&22 : most significant two digits of trigger delay setting
byte 23&24 : least significant two digits of trigger delay setting
The other 256 times 2 bytes contain the waveform data


R X del. del. del. del. del. del. del. del. del. del.
1 2 3 4 5 6 7 8 9 10 11 12
del. del. del. del. del. del. del. del. del. del.
13 14 15 16 17 18 19 20 21 22 23 24
del. del.
25 26
◄ DATA ►
535 536
◄ DATA ►

256 groups of 2 DATA bytes

In dual channel mode first the 128 groups of 2 DATA bytes for channel A have to be send and then the 128 groups of 2 DATA bytes for channel B.
(The maximum byte length inclusive delimiters is 804 bytes.)

Generally the settings of channel A, B and the TIME-BASE are in scientific notation.
That is: sign of exponent + exponent + mantissa.

3.6. REGISTER DATA CONVERSION TABLES

3.6.1. Settings YA, YB and TB

BYTE 3&4, 5&6, 9&10, 11&12, 15&16 and 17&18 or the settings from YA, YB and TB.
Generally the settings of channel A, B and time base are in scientific notation (sign of exponent + exponent + mantissa).
In the oscilloscope: bytes 3, 9 and 15 are the sign of the exponent; this byte is 1 if the sign is negative and Ø if positive.
The bytes 4, 10 and 16 are the exponent number (power of 10).
This number can be between 3 and Ø for the bytes 4 and 10 and between 8 and Ø for byte 16.
(This difference is because the attenuators are from 10E-3 till 500 V and the time base from 5E-9 till 3600 s.).
The bytes 5&6, 11&12 and 17&18 contain the mantissa.
The decimal point has to be thought on the left side of this group.
The value of the mantissa is therefore always between 0,1 and 0,99 including.

3.6.2. Byte 8 and 14: Mode of channels A and B

Value byte 8/14	ADD/BINV	Channel ON	Channel ZERO	Channel AC coupled	Channel DC coupled
Ø	YES	YES	YES	YES	NO
1	YES	YES	YES	NO	YES
2	YES	YES	NO	YES	NO
3	YES	YES	NO	NO	YES
8	NO	YES	YES	YES	NO
9	NO	YES	YES	NO	YES
A	NO	YES	NO	YES	NO
B	NO	YES	NO	NO	YES
F	NO	NO	NO	NO	YES

The bytes 8 and 14 are different in one position:
ADD in byte 8 and B-INVERT in byte 14. For the table here listed there is no difference.

3.6.3. Byte 7: Mode channel A (cont'd)

Byte 7	Calibrated	Uncalibrated	A or B A + B	A&B	Odd	Even
Ø	YES	NO	NO	YES	NO	YES
1	NO	YES	NO	YES	NO	YES
2	YES	NO	YES	NO	–	–
3	NO	YES	YES	NO	–	–
4	YES	NO	NO	YES	YES	NO
5	NO	YES	NO	YES	YES	NO
6	YES	NO	YES	NO	–	–
7	NO	YES	YES	NO	–	–

The columns A or B/A + B and A&B express whether the memory of the oscilloscope is filled with one or two waveforms (from channel A and B).
The columns odd and even are valid only when there are two waveforms in the memory.

3.6.4. Byte 13: Mode channel B (cont'd) Mode time base

Byte 13	Channel B:		Time base mode:		
	calibrated	uncalibrated	roll	single	multiple
Ø	YES	NO	NO	NO	NO
1	NO	YES	NO	NO	NO
2	YES	NO	NO	NO	YES
3	NO	YES	NO	NO	YES
4	YES	NO	NO	YES	NO
5	NO	YES	NO	YES	NO
8	YES	NO	YES	NO	NO
9	NO	YES	YES	NO	NO

If byte 13 is Ø or 1, the time base mode is recurrent (default)

3.6.5. Bytes 19&20, 21&22 and 23&24: trigger delay part

These 6 bytes together make the current trigger delay setting of the accumulator.
Byte 19 is Ø if the sign is positive and F if negative.
Byte 20 is Ø if no under or overflow on the settings exists.
is C in case of overflow and 3 at underflow.
(overflow is an attempt to set trigger delay beyond 9999)

The bytes 21, 22, 23 and 24 contain a decimal value.
All together they form the value of the trigger delay setting.
Byte 21 is the most significant digit, byte 24 the least significant.

3.6.6. The other 256 times 2 bytes

These bytes contain the values of the waveform that is in memory.

* The data in the oscilloscope is in two's complement notation.
On the bus the information is also in two's complement form (see 3.11.).

The way this data is send over the bus differs with the number of channels that are active.
(The total length however remains unchanged.)

* If there is one channel active (test on bytes 8 and 14), all values transmitted are from that channel measured waveform.
* If the oscilloscope was in ADD mode, all points are the ADDed result of channel A plus channel B (test on byte 8).
* If there were two channels active (A&B), then the first 128 times 2 bytes belong to the waveform in channel A, the other 128 times 2 bytes belong to channel B (test on byte 7).

The odd/even parameter in byte 7 points out which memory position in the oscilloscope channel A is standing (especially usefull when transmitting pictures in A versus B mode).

3.7. SERVICE REQUEST (SRQ)

The oscilloscope is capable to send a SRQ to indicate a special condition of the instrument.
A request for service is given:

1. If measurements are finished (only measurements started with the DEVICE TRIGGER command).
2. If data is ready to be output to the controller.
3. If an incorrect programming code has been received.

After a SRQ, the controller can address the oscilloscope as "serial poll talker", than the status word is set on the Bus (DIO8....DIO1).
The SRQ-message is automatically reset after acknowledge from the controller. Via SERIAL POLL (1. and 3.) or reading the data (2.).

Reading the device status word of the oscilloscope

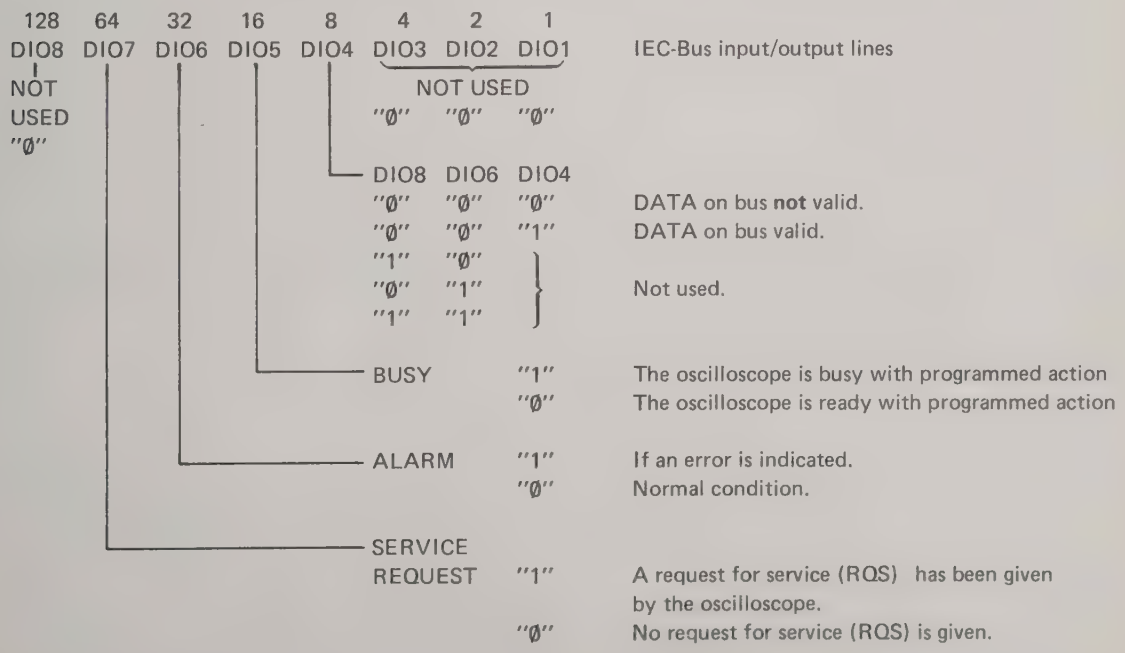
The status word can be read by programming a SERIAL POLL action.

- Send UNListen
- Make controller LISTENER
- Send SPE (Serial Poll Enable)
- Make the oscilloscope TALKER
- Read STATUS-word
- Send UNTalk
- Send SPD (Serial Poll Disable)

The STATUS-word of the oscilloscope

The status figure can have a few different values:
Ø : nothing of interest is happening.
8 : valid data is on the bus (used during transfer)
16 : scope is busy with a programmed measurement
32 : something is wrong: ALARM
64 : the scope has an active service request
There can also be a combination of these basic values e.g. when the scope is ready with a measurement it activates the service request. The STATUS would be ⩾ 64 now.
By waiting on a service request after a device trigger the controller can check when the scope is ready with that measurement.

The STATUS BYTE from the PM 3310 is built up as follows:


128 64 32 16 8 4 2 1
DIO8 DIO7 DIO6 DIO5 DIO4 DIO3 DIO2 DIO1
IEC-Bus input/output lines
NOT USED "Ø"
NOT USED
"Ø" "Ø" "Ø"
DIO8 DIO6 DIO4
"Ø" "Ø" "Ø" DATA on bus not valid.
"Ø" "Ø" "1" DATA on bus valid.
"1" "Ø"
"Ø" "1" Not used.
"1" "1"
BUSY "1" The oscilloscope is busy with programmed action
"Ø" The oscilloscope is ready with programmed action
ALARM "1" If an error is indicated.
"Ø" Normal condition.
SERVICE REQUEST "1" A request for service (RQS) has been given by the oscilloscope.
"Ø" No request for service (RQS) is given.

3.8. DEVICE TRIGGER COMMAND

It is possible for the controller to tell the scope when to start taking measurements by using the IEC bus GET (Group Execute Trigger) command. This is done by sending:

8 (decimal)

Since there are four modes of measurement (recurrent, single, multiple and roll) there are four different interpretations possible for the oscilloscope:

Recurrent : no interpretation, measurements are continuous
Single : re-arm the single shot mode
Multiple : re-arm the multiple mode
Roll : start the roll mode.

The ROLL-mode can be stopped by sending a front panel string compatible with the actual front panel, but with Byte 14 (Busy-bit) is Ø. (See page 8, section 3.4.4.).

For all these modes there will be a service request after the measurement is ready. This service request will stay active until the status of the oscilloscope is loaded into the controller.
After this, the service request is resetted by the oscilloscope and can be enabled by a new GET (Group Execute Trigger).

3.9. GO TO LOCAL COMMAND

There are only two ways to get the oscilloscope out of the remote situation and these are: hardware reset (power off, power on) and via an IEC - bus command GTL (Go To Local).
To get the oscilloscope out of its current remote situation send:

1 (decimal)

After executing this line the oscilloscope is listening again to the knobs at the frontpanel.

3.10. SELECTIVE DEVICE CLEAR COMMAND

The oscilloscope is capable of receiving and executing a device clear command from the IEC-bus.
The controller asks for a device clear by sending:

4 (decimal)

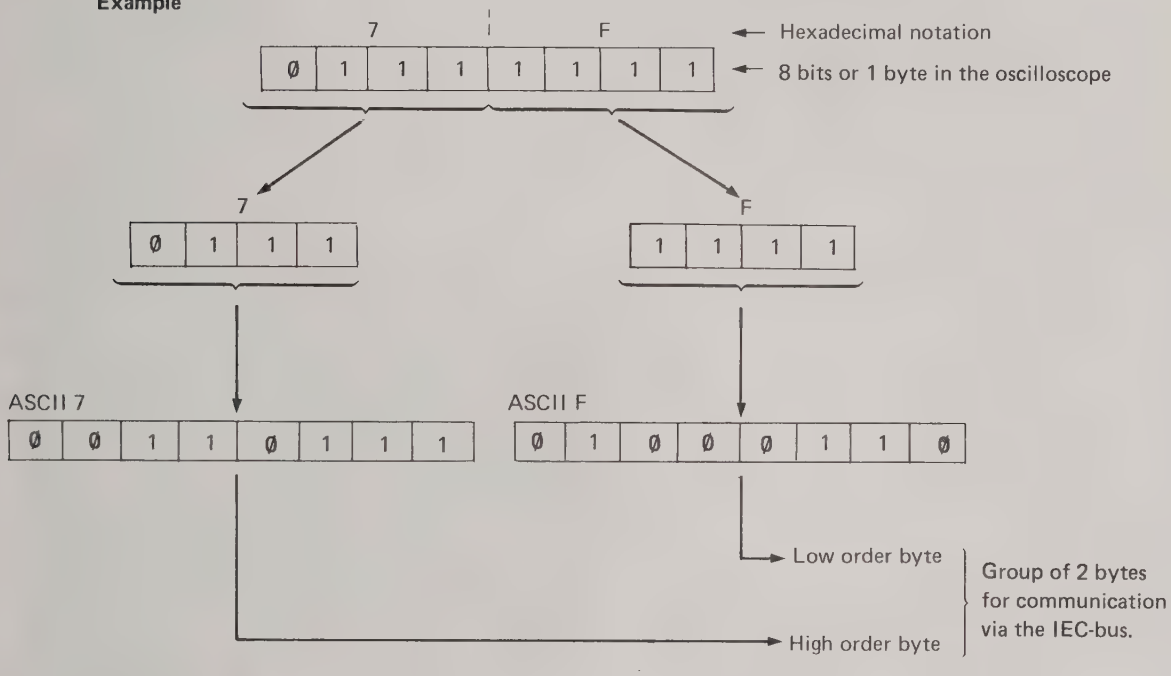
The oscilloscope will, on receiving, execute the following routines:

* Clear the PM 3325 (IEC Hardware/software interface) software work space.
* Clear trigger delay digits to zero. (Reset of the clearing is done by the oscilloscope).
* Place a new frontpanel situation that exists when all pushbuttons on the oscilloscope are released. (see figure 3.14. of chapter 3.4. of the Operating Manual).
* Default setting of YA attenuator → 0.1 V/DIV.
* Default setting of YB attenuator → OFF.
* Default setting of TB switch → 0.5 ms/DIV.

3.11. SOME REMARKS

* ESC can be generated by the controller using 27 decimal.
* The oscilloscope always will transmit two bytes + delimiter.
* These two bytes are two nibbles of the HEX representation of one byte in the oscilloscope. Example: If the controller reads from the bus: 7 F del., this means: 7 F is one byte in the oscilloscope (if it would be register data then there would be a memory overflow on the CRT of the oscilloscope).

Example


7
F
Hexadecimal notation
Ø 1 1 1 1 1 1 1
8 bits or 1 byte in the oscilloscope
7
F
Ø 1 1 1
1 1 1 1
ASCII 7
Ø Ø 1 1 Ø 1 1 1
ASCII F
Ø 1 Ø Ø Ø 1 1 Ø
Low order byte
High order byte
Group of 2 bytes for communication via the IEC-bus.

Conversion table

Hexadecimal character	ASCII character	ASCII code	Hexadecimal ASCII code	Decimal ASCII code
Ø	Ø	ØØ11 ØØØØ	3Ø	48
1	1	ØØ11 ØØØ1	31	49
2	2	ØØ11 ØØ1Ø	32	5Ø
3	3	ØØ11 ØØ11	33	51
4	4	ØØ11 Ø1ØØ	34	52
5	5	ØØ11 Ø1Ø1	35	53
6	6	ØØ11 Ø11Ø	36	54
7	7	ØØ11 Ø111	37	55
8	8	ØØ11 1ØØØ	38	56
9	9	ØØ11 1ØØ1	39	57
A	A	Ø1ØØ ØØØ1	41	65
B	B	Ø1ØØ ØØ1Ø	42	66
C	C	Ø1ØØ ØØ11	43	67
D	D	Ø1ØØ Ø1ØØ	44	68
E	E	Ø1ØØ Ø1Ø1	45	69
F	F	Ø1ØØ Ø11Ø	46	7Ø

* It is possible that the first buffer returned by the oscilloscope on request of the controller contains three in stead of two bytes. This can only happen the first time after power up.

Solution

Perform SERIAL POLL at the start of any programm and disregard the returned information.

3.12. SOME PROGRAM EXAMPLES

After power up the delimiter must be defined (see chapter 3.13.1.).
In all examples, the oscilloscope is assumed to be set to address 8.
Also the PM 4400 or PM 4401 is assumed to be the controller.

3.12.1. Load a front panel setting in the controller

This program contains some programs that can be executed to demonstrate the given programs.

As we know by now the controller has to send an ESC Ø sequence.
This is done by programming:

```
100 PRINT # 8; CHRS (27); "ØMTØØ"
```

The oscilloscope then answers with 13 times 2 bytes (+13 delimiters).
These bytes can be read on several ways, we use a string-array:

```
110 DIM FRONT$ (13,2)
120 FOR I=1 TO 13
130 INPUT #8: FRONT$ (I)
140 PRINT FRONT$; " , " ;
150 NEXT I
```

The current frontpanel settings are now stored in the FRONT string-array (line 140 is used to print the result).
Now it is possible to calculate in what setting the scope was put in by a previous program action or by the scopes operator.

Here under an example is given from the output of the above program.

MT 44 ØB 64 ØB 3Ø 1Ø CE 7Ø 1E ØØ 67 89

3.12.2. Write a new front panel into the oscilloscope

First we must define what the new frontpanel setting will be.
This can be done by a simple LET statement.
We will program the oscilloscope with the following settings:
YA : .5 V/DIV and ON, YB : 1 V/DIV and ON ; TB : .2 ms/DIV and recurrent registers ACCU, ST01 displayed, no register inverted YX1 display, dots, register ACCU selected for scaling, no register saved and no plot.
The trigger delay will be set on 6789. The program looks like this:

```
100 DIM NEWFRN$(3Ø)
110 LET NEWFRN$ = "MT44ØB64ØB3Ø1ØCE7C1EØØ6789"
120 PRINT #8: CHR$ (27); "Ø"; NEWFRN$
```

3.12.3. Read a register into the controller

Before the controller can read the register data, the scope must be programmed by an ESC Ø sequence like:

```
100 PRINT #8: CHR$(27); "ØRKØØ"
```

(note that this instruction will ask for the ACCU)
The oscilloscope will now send 268 times 2 bytes (+ delimiters) and the controller must read them. We now will read this data byte after byte from the bus (a string array can be used also) like:

```
110 DIM REG(268,2)
120 PWRITE 32,72:                          / REMARK : MAKE OSCILLOSCOPE TALKER /
130 FOR I=1 TO 268
140 PREAD K,L,E                    / K AND L ARE THE DATA BYTES E DELIMITER /
150 LET REG(I,1)=K                                        / PLACE K IN ARRAY /
160 LET REG(I,2)=L                                        / PLACE L IN ARRAY /
170 REM ** THE DELIMITER CAN BE DROPPED : NO RELEVANT INFO
180 NEXT I
190 PWRITE 95:                                            / UNTALK SCOPE /
```

REMARK: Line 190 is necessary because of the PM 4400-structure.
If this line is not implemented the CRT will stay dark since the PM 4400 does not finish the handshake of the IEC-bus.

3.12.4. Write a new register into the oscilloscope

It is also possible to write new register information into the oscilloscope.
In the example listed we will transfer the register which was read with the previous example back into ST01.

```
100 PRINT #8: "RL"                                        / PROGRAM RL /
110 FOR I=2 TO 268                          / FIRST TO BYTES WHERE R AND K /
120 PRINT #8: CHR$(REG(I,1));CHR$(REG(I,2))
130 NEXT I
```

3.13. SOME MORE PROGRAM EXAMPLES

3.13.1. Define a new delimiter

The program for the PM 4400 will be:

```
100 PRINT #8: CHR$(27); "ØDDØ"
```

because the PM 4400 will fill the delimiter position.
On the other hand, this program is not necessary when a PM 4400 is used to program the oscilloscope because the delimiter value in the PM 4400 is ETX and this is also the default value in the oscilloscope after power up.

This command is therefore very usefull when a controller does not know the ETX as a delimiter : with this instruction it can program the oscilloscope to listen to the delimiter known by the controller.

3.13.2. Change the front panel

Let us assume that we have input the following frontpanel:
MT44ØB64ØB3Ø1ØCE7C1EØØ6789 (example of page 24) and we want to change the attenuator setting of YB into 2 V/DIV.
This can be done like:

```
100 REM FRONT$ IS JUST INPUT FROM THE OSCILLOSCOPE
110 LET FRONT$=SUBSTR$(FRONT$,1,6)+"6Ø"+SUBSTR$(FRONT$,9,26)
```

Now the FRONT$ will be : MT44ØB6ØØB3Ø1ØCE7C1EØØ6789 and this new string can be send to the oscilloscope to change the YB setting.

This example can also be used to change register data.
Then we suggest however that the register data is stored in a string array the change is even simpler: just change the specified array position by : LET REG$(I)=new data string.

3.13.3. ASCII → Decimal conversion (to translate 2 bytes into one decimal)

```
100 REM @ ENTRY : HIGH IS HIGH ORDER BYTE
110 REM         : LOW IS LOW ORDER BYTE
120 REM @ EXIT  : RESULT IS THE DECIMAL VALUE
130 REM**
140 IF HIGH<64 THEN 160
150 LET HIGH=HIGH-7
160 IF LOW<64 THEN 180
170 LET LOW=LOW-7
180 LET RESULT=(HIGH-48)*16+(LOW-48)
190 RETURN
```

Of course this is only an example of how it can be done but it is a relative simple conversion.

3.13.4. DECIMAL → ASCII conversion (to translate one decimal into two bytes)

```
REM @ ENTRY : FIGURE IS DECIMAL TO BE CONVERTED
REM @ EXIT  : HIGH IS HIGH ORDER BYTE
REM         : LOW IS LOW ORDER BYTE TO TRANSMIT
REM
100 LET B$="Ø123456789ABCDEF"
110 LET I=1
120 LET FIGURE2=FIGURE                          /BACK UP INPUT VALUE/
130 LET FIGURE2=FIGURE 2-16                     /CALCULATE HIGH ORDER HEX FIGURE/
140 IF FIGURE2 < =Ø THEN 170
150 LET I=I+1
160 GOTO 130
170 LET HIGH$=SUBSTR$(B$,I,1)                   /CALCULATE HIGH$ CHARACTER/
180 LET LOW$=SUBSTR$(B$, (FIGURE I*16),1)       /LOW$ CHARACTER/
190 RETURN
```

COLUMN →		0			1			2			3			4			5			6			7		
ROW	b7 → b6 → b5 →	0 0 0			0 0 1			0 1 0			0 1 1			1 0 0			1 0 1			1 1 0			1 1 1		
	b4 b3 b2 b1 ↓	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1
0	0 0 0 0	NUL	0		DLE	16		SP	32	0	0	48	16	@	64	0	P	80	16	`	96		p	112	
1	0 0 0 1	SOH	1	GTL	DC1	17	LLO	!	33	1	1	49	17	A	65	1	Q	81	17	a	97		q	113	
2	0 0 1 0	STX	2		DC2	18		"	34	2	2	50	18	B	66	2	R	82	18	b	98		r	114	
3	0 0 1 1	ETX	3		DC3	19		#	35	3	3	51	19	C	67	3	S	83	19	c	99		s	115	
4	0 1 0 0	EOT	4	SDC	DC4	20	DCL	$	36	4	4	52	20	D	68	4	T	84	20	d	100		t	116	
5	0 1 0 1	ENQ	5	PPC	NAK	21	PPU	%	37	5	5	53	21	E	69	5	U	85	21	e	101		u	117	
6	0 1 1 0	ACK	6		SYN	22		&	38	6	6	54	22	F	70	6	V	86	22	f	102		v	118	
7	0 1 1 1	BEL	7		ETB	23		'	39	7	7	55	23	G	71	7	W	87	23	g	103		w	119	
8	1 0 0 0	BS	8	GET	CAN	24	SPE	(	40	8	8	56	24	H	72	8	X	88	24	h	104		x	120	
9	1 0 0 1	HT	9	TCT	EM	25	SPD	)	41	9	9	57	25	I	73	9	Y	89	25	i	105		y	121	
10 A	1 0 1 0	LF	10		SUB	26		*	42	10	:	58	26	J	74	10	Z	90	26	j	106		z	122	
11 B	1 0 1 1	VT	11		ESC	27		+	43	11	;	59	27	K	75	11	[	91	27	k	107		{	123	
12 C	1 1 0 0	FF	12		FS	28		,	44	12	<	60	28	L	76	12	\	92	28	l	108		|	124	
13 D	1 1 0 1	CR	13		GS	29		–	45	13	=	61	29	M	77	13	]	93	29	m	109		}	125	
14 E	1 1 1 0	SO	14		RS	30		.	46	14	>	62	30	N	78	14	^	94	30	n	110		~	126	
15 F	1 1 1 1	SI	15		US	31		/	47	15	?	63	UNL	O	79	15	_	95		o	111		DEL	127	

ADDRESSSED COMMAND GROUP

UNIVERSAL COMMAND GROUP

LISTEN ADDRESS GROUP

TALK ADDRESS GROUP

SECONDARY ADDRESS GROUP

4. FUNCTIONAL TESTS

This chapter gives a functional test of the system combination:
Oscilloscope – IEC interface – IEC BUS controller.

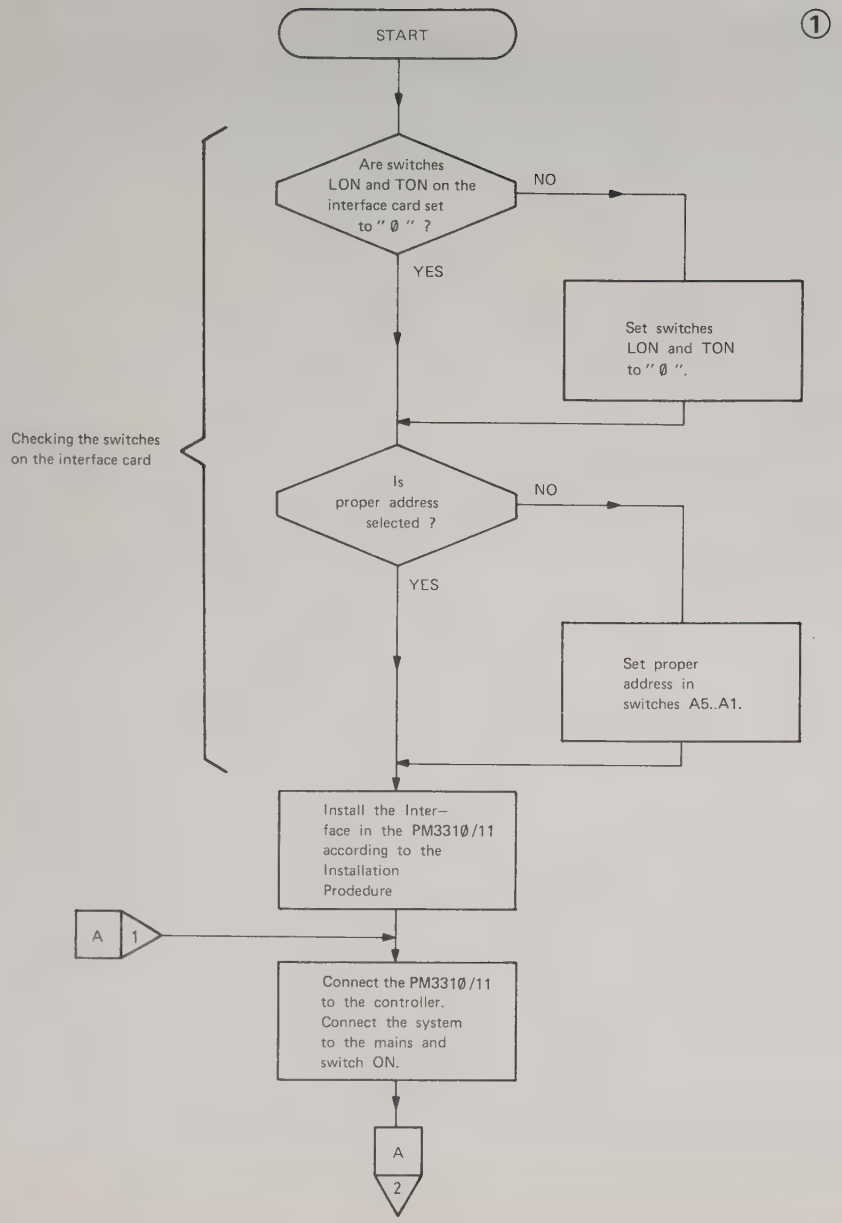
The undermentioned functions can be checked:

- Device address settings on interface card
- Switching to REMOTE control
- GO TO LOCAL
- Register transfer
- Define delimiter
- Frontpanel transfer
- DEVICE CLEAR
- DEVICE TRIGGER
- SERIAL POLL + reading the STATUS-word.

The programs are suitable for 3 controllers viz.:

- PM 4401 page 29
- HP-85 page 35
- CBM-4032 page 41

On each page a part of the flow-chart together with the corresponding literally program is given.

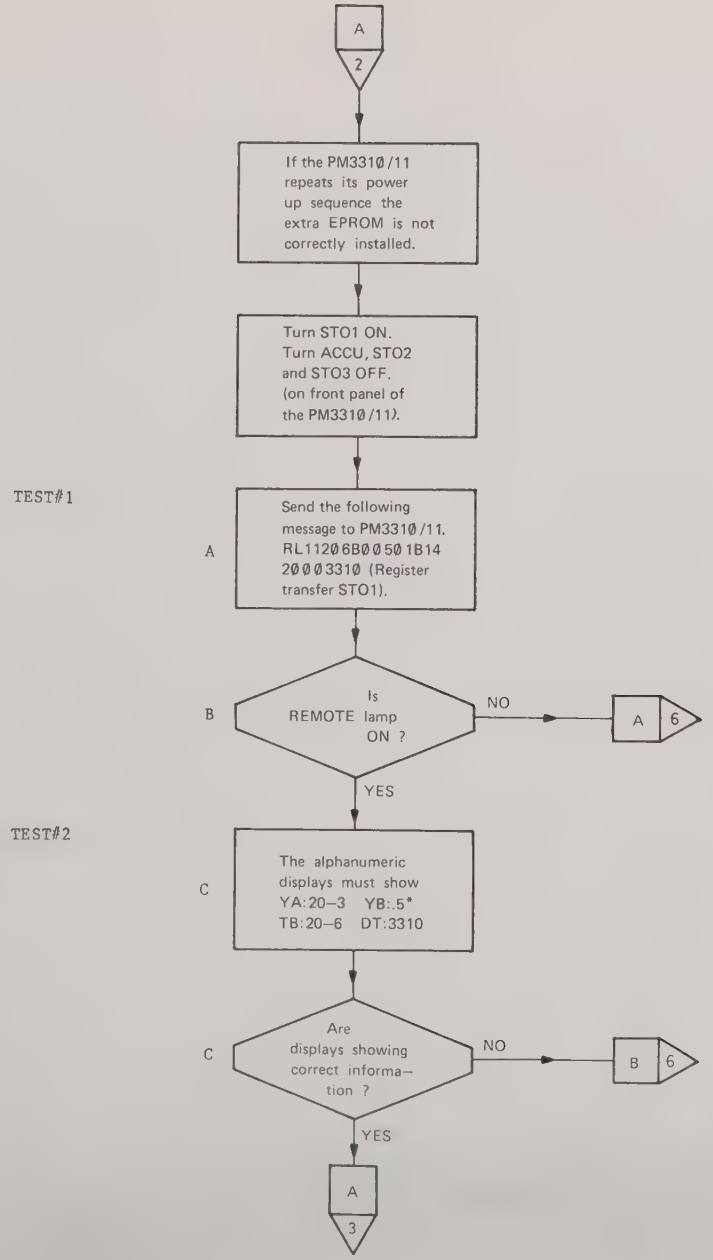

①
START
Are switches LON and TON on the interface card set to " Ø " ?
NO
YES
Set switches LON and TON to " Ø ".
Checking the switches on the interface card
Is proper address selected ?
NO
YES
Set proper address in switches A5..A1.
Install the Inter–face in the PM3310/11 according to the Installation Prodedure
A 1
Connect the PM3310/11 to the controller. Connect the system to the mains and switch ON.
A 2

PM 4401 IEC-SOFTWARE

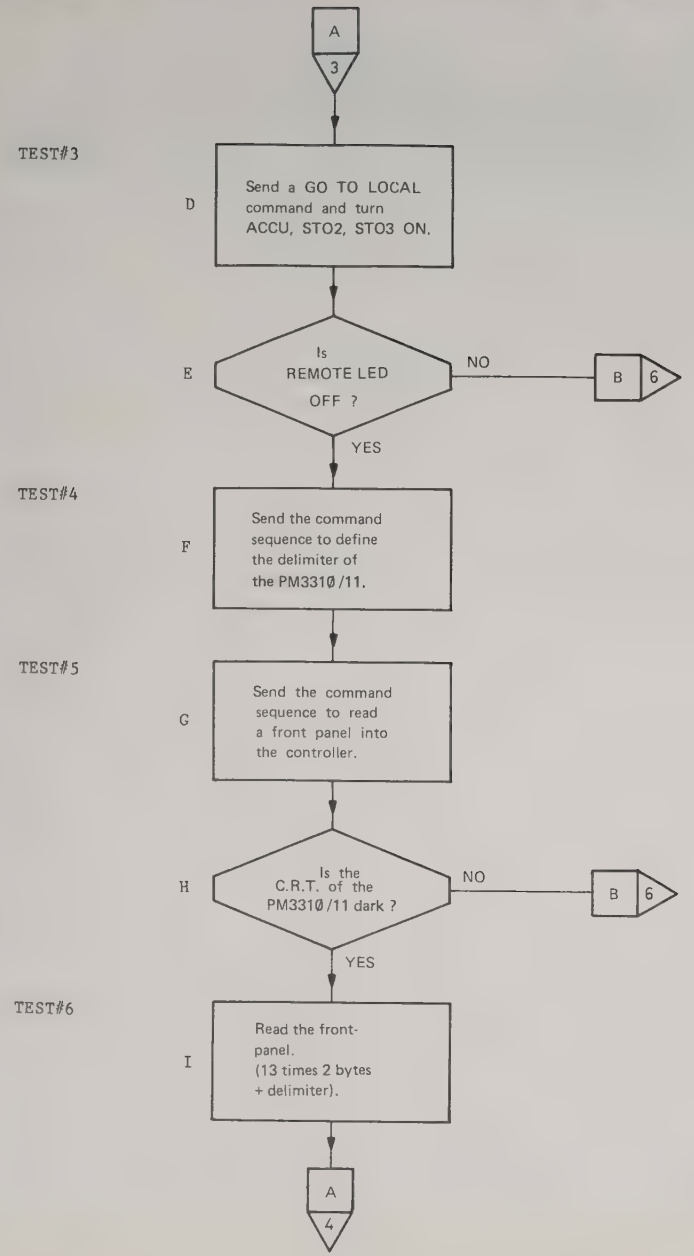
****FUNCTIONAL CHECK****

INITIALIZATION

```
100   INIT
110   PAGE
120   DIM FRONT$(13,3),REG$(268,3)
130   PRINT" FUNCTIONAL TEST"
140   PRINT"**************************,,
150   PRINT"   SET-UP INSTRUCTIONS"
160   PRINT" –ASSURE THAT LON AND TON"
170   PRINT"   SWITCHES ON INTERFACE"
180   PRINT"   CARD ARE SET TO Ø."
190   PRINT" –SET ADDRESS SWITCHES TO 8."
200   PRINT" –ON PM 3310/11:"
210   PRINT"   TURN STO1 ON."
220   PRINT"   TURN ACCU, STO2 AND STO3"
230   PRINT"   OFF."
240   PRINT"PRESS 'CON' KEY TO CONTINUE."
250   STOP
```

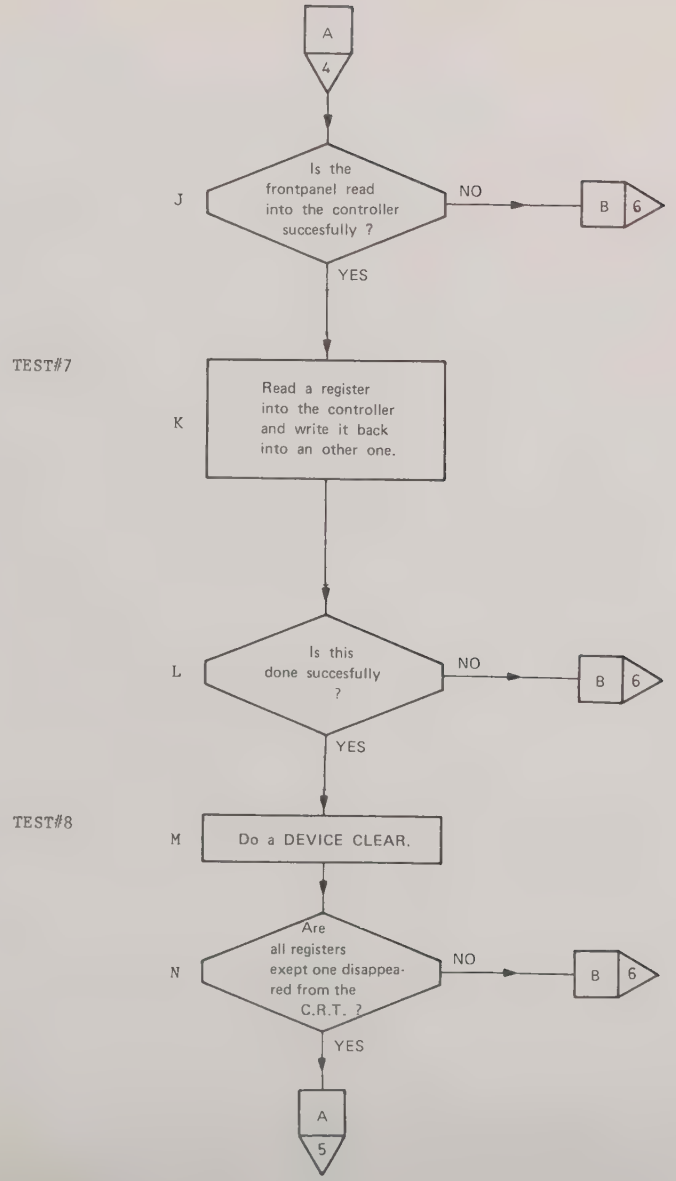



```
260   REM ** TEST # 1:
270   REM ** CHECK IF INSTRUMENT GOES TO REMOTE.

280   REM ** A
290   PAGE
300   PRINT"TEST#1:"
310   PRINT#8:"RL11206B00501B1420003310"

320   REM ** B
330   PRINT"IS REMOTE LED ON (Y OR N) ?";
340   GOSUB 1460

350   REM ** TEST # 2:
360   REM ** CHECK IF LED DISPLAYS ARE LOADED CORRECT

370   REM ** C
380   PAGE
390   REM ** PRINT"TEST#2:"
400   PRINT"CHECK ALPHANUMERIC DISPLAYS:"
410   PRINT"      YA: 20-3       YB: .5*"
420   PRINT"      TB : 20-6      DT: 3310"

430   PRINT"   OK (Y OR N) ? ";
440   GOSUB 1460
```



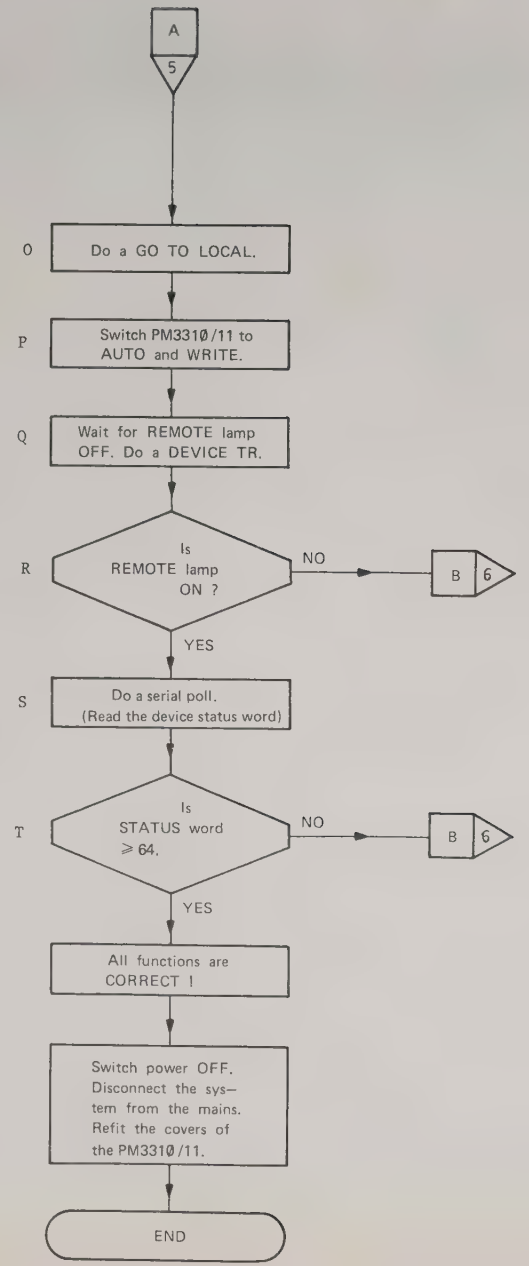
③

```
450  REM ** TEST # 3 :
460  REM ** CHECK RESPONSE TO GO TO LOCAL COMMAND

470  REM ** D
480  PAGE
490  PRINT"TEST#3:"
500  PRINT#8,1:
510  PRINT"  TURN ACCU, STO2 AND STO3 ON"
520  PRINT"  MANUALLY, SELECT STO1 FOR"
530  PRINT"  LED DISPLAY."

540  REM ** E
550  PRINT"  IS REMOTE LED OFF (Y OR N) ? ";
560  GOSUB 1460

570  REM ** TEST # 4:
580  REM ** CHANGE DELIMITER + WAIT TIME
590  PAGE
600  PRINT"TEST#4:"

610  REM ** F
611  REM ** THE PROGRAMMING OF THE DELIMITER
612  REM ** IS NOT NECESSARY FOR THE PM 4401,
613  REM ** BECAUSE ITS DELIMITER IS ALREADY ETX

630  REM ** TEST # 5 :
640  REM ** CHECK RESPONSE TO READ FRONTPANEL COMMAND.

650  REM ** G
660  PAGE
670  PRINT"TEST#5:"
680  PRINT#8:CHR$(27); "ØMTØØ"

690  REM ** H
700  PRINT" IS PM 3310/11 C.R.T. DARK (Y OR N) ? ";
710  GOSUB 1460

720  REM ** TEST # 6 :
730  REM ** READ FRONTPANEL SETTINGS

740  REM ** I
750  PAGE
760  PRINT"TEST#6:"
770  FOR I=1 to 13
780  INPUT#8:FRONT$(I)
790  PRINT FRONT$(I);",";
800  NEXT I
```



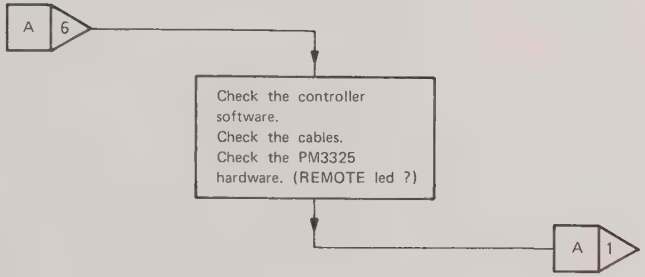

```
810  REM ** J
820  PRINT/, "CHECK IF 13 GROUPS OF TWO BYTES ARE"
830  PRINT"RECEIVED STARTING WITH 'MT'."
840  PRINT"   OK (Y OR N) ? ";
850  GOSUB 1460

860  REM ** TEST # 7 :
870  REM ** READ ACCU INTO PM 4401 AND
880  REM ** THEN STORE INTO STO1 IN PM 3310/11

890  REM ** K
900  PAGE
910  PRINT"TEST#7:"
920  PRINT#8:CHR$(27); "ØRKØØ"
930  FOR I=1 TO 268
940  INPUT #8:REG$(I)
950  NEXT I
960  PRINT#8:"RL"
970  FOR I=2 TO 268
980  PRINT#8:REG$(I)
990  NEXT I

1000 REM ** L
1010 PRINT"WAS REGISTER TRANSFER"
1020 PRINT"SUCCESSFUL (Y OR N) ? ";
1030 GOSUB 1460

1040 REM ** TEST # 8 :
1050 REM ** CHECK RESPONSE TO DEVICE CLEAR

1060 REM ** M
1070 PAGE
1080 PRINT"TEST#8: "
1090 PRINT#8,4:

1100 REM ** N
1110 PRINT"HAVE ALL REGISTERS BUT ONE DISAPPEARED"
1120 PRINT"FROM SCREEN (Y OR N) ? ";
1130 GOSUB 1460
```

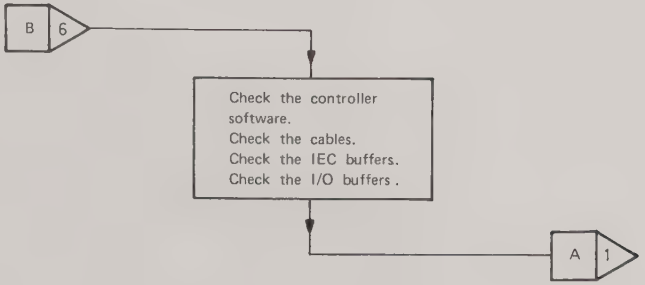
TEST#9




```
1140  REM ** TEST # 9 :
1150  REM ** SET-UP INSTRUMENT FOR TRIGGER COMMAND
1160  REM ** CHECK RESPONSE TO DEVICE TRIGGER
1170  REM ** READ STATUS REGISTER AND DISPLAY ON
1180  REM ** PM 4401 SHOULD BE >= '64'.

1190  REM ** O
1200  PAGE
1210  PRINT"TEST#9:"
1220  PRINT#8,1:

1230  REM ** P
1240  PRINT"SWITCH PM 3310/11 TO AUTO AND WRITE."
1250  PRINT"SWITCH PM 3310/11 TO RECURRENT."

1260  REM ** Q
1270  PRINT"IS REMOTE LAMP OFF (Y OR N) ? ";
1280  GOSUB 1460
1290  PRINT#8,8:


1300  REM ** R
1310  PRINT"IS REMOTE LAMP ON (Y OR N) ? ";
1320  GOSUB 1460


1330  REM ** S
1340  PWRITE63,32,24,72:
1350  PREAD STATUS
1360  PWRITE95,25:
1370  PRINT"STATUS WORD = ";STATUS

1380  REM ** T
1390  PRINT"IS STATUS WORD >='64' (Y OR N) ? ";
1400  GOSUB 1460



1410  REM ** END OF TEST:

1420  PAGE
1430  PRINT///////, "PM 3310/11/3325 OK . SUCCES !! "
1440  DELAY 1
1450  GOTO 1420
```

⑥

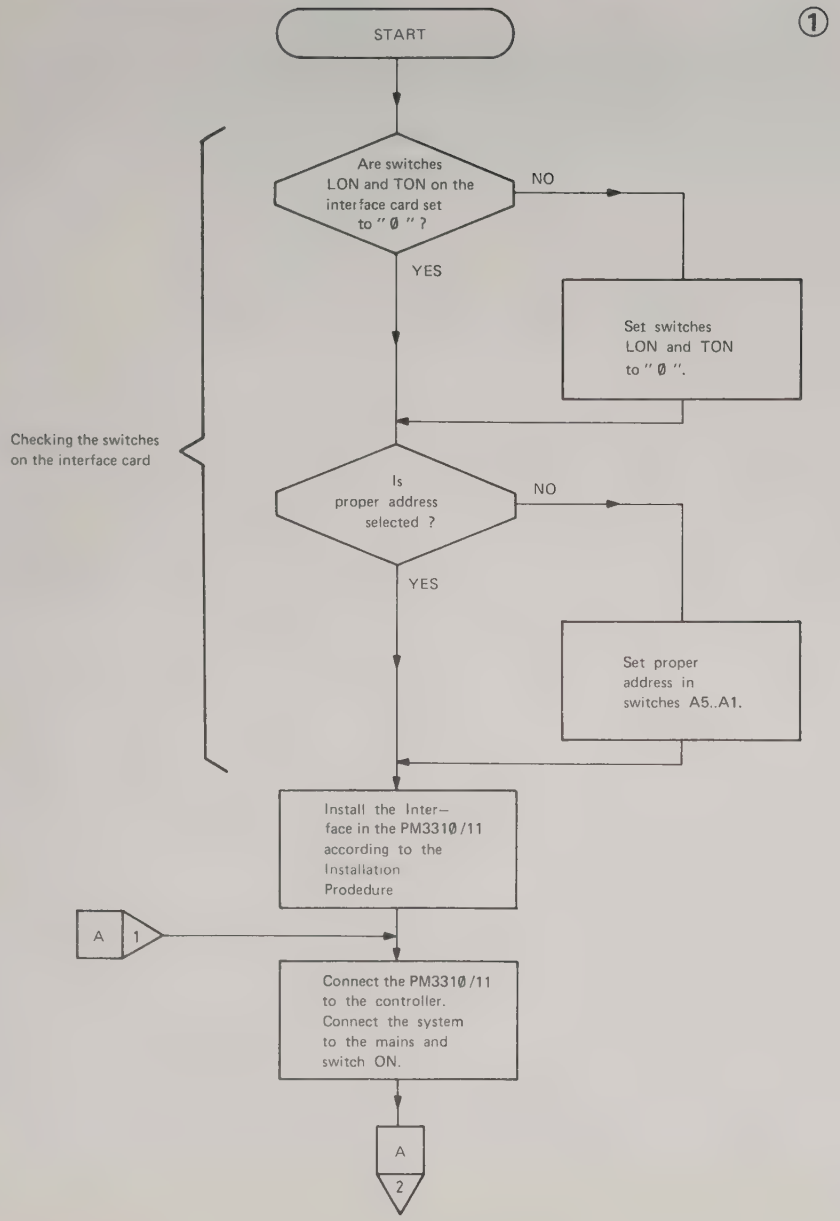




SUBROUTINE

```
1460  REM ** RESPONSE TO DISPLAY (PM 4401) QUESTIONS
1470  REM ** IF YES CONTINUE – IF NO DETERMINE
1480  REM ** PROBLEM AND CONTINUE TEST

1490  INPUT A$
1500  IF A$="N" THEN 1520
1510  RETURN
1520  PRINT///, "CORRECT ERROR CONDITION"
1530  PRINT"PRESS 'RUN' – KEY TO RESTART'
1540  PRINT"THIS FUNCTIONAL CHECK"
1550  END
```

**********END**********

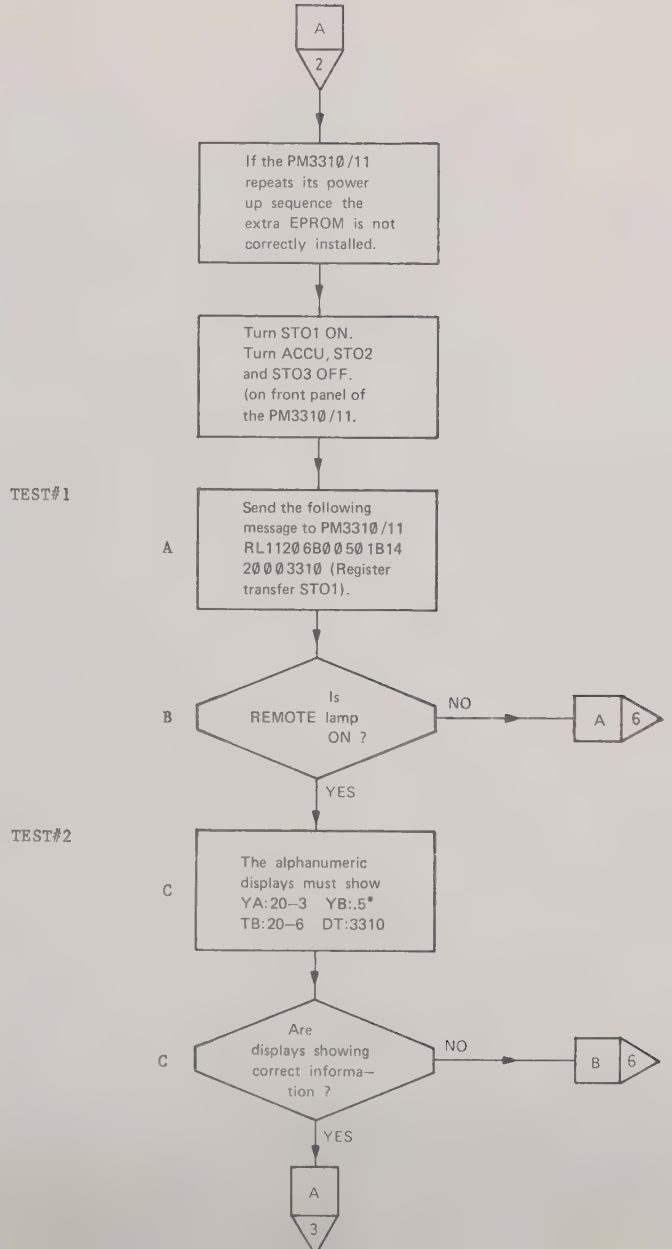

①
START
Are switches LON and TON on the interface card set to " 0 " ?
NO
YES
Set switches LON and TON to " 0 ".
Checking the switches on the interface card
Is proper address selected ?
NO
YES
Set proper address in switches A5..A1.
Install the Inter-face in the PM3310/11 according to the Installation Prodedure
A 1
Connect the PM3310/11 to the controller. Connect the system to the mains and switch ON.
A 2

HP 85 IEC-SOFTWARE FOR PM3310/PM3325

****FUNCTIONAL CHECK****

INITIALIZATION
==========

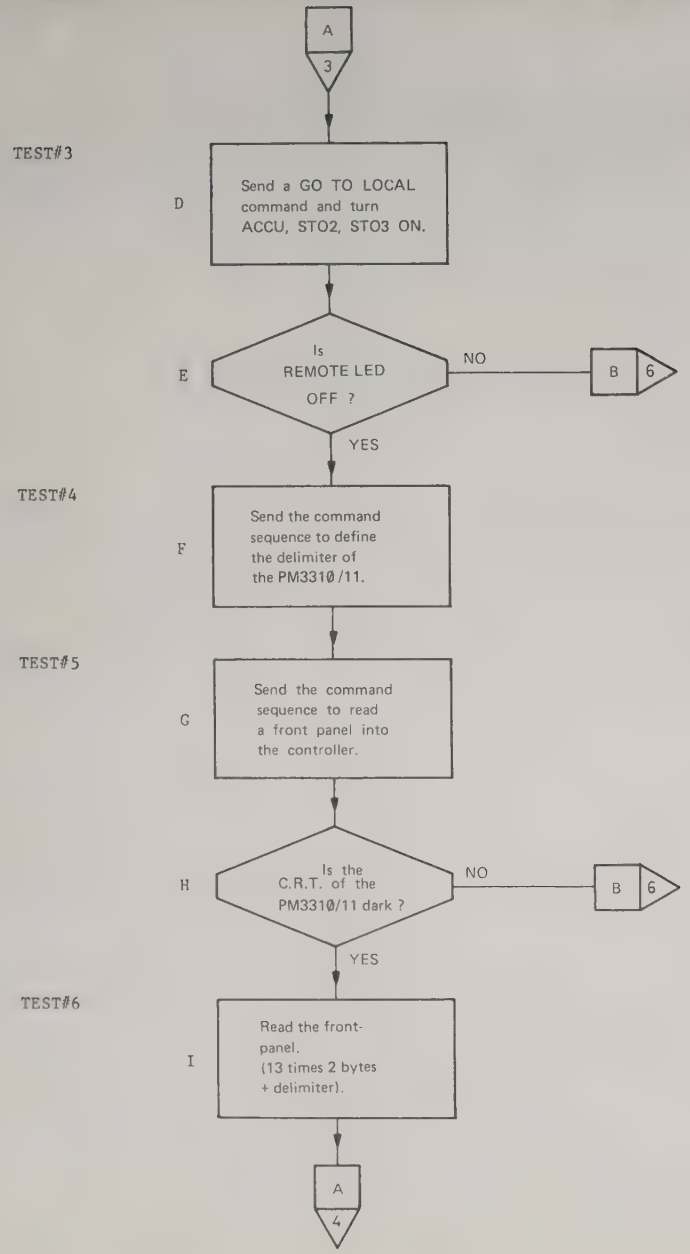
```
 10 ! ** OSC 120, MODIFIED
 20 ! ** Modificationdate: 8/15/
    82
 30 DIM F$[26],R$[536],B$[3]
 40 SET TIMEOUT 7;3000
 50 ON TIMEOUT 7 GOTO 1840
 60 OPTION BASE 1
 70 E$=CHR$(27)
 80 CLEAR
 90 DISP "PM3310/3325 FUNCTIONAL
    TEST"
100 DISP "-----------------------
    ---------"
110 DISP ""
120 DISP "Setup instructions:"
130 DISP "_ASSURE THAT LON AND T
    ON"
140 DISP "  SWITCHES ON INTERFAC
    E"
150 DISP "  CARD ARE SET TO 0."
160 DISP "-SET ADDRESS SWITCHES
    TO 8"
170 DISP "-ON PM 3310:"
180 DISP "  TURN-ON STO 1"
190 DISP "  TURN-OFF ACCU, STO 2
     AND STO 3"
200 DISP ""
210 BEEP
220 DISP "PRESS ENDLINE WHEN"
230 DISP "READY TO CONTINUE"
240 INPUT X$
250 CLEAR
260 ! ** ETX IS END LINE
270 CONTROL 7,16 ; 1,3
```



②

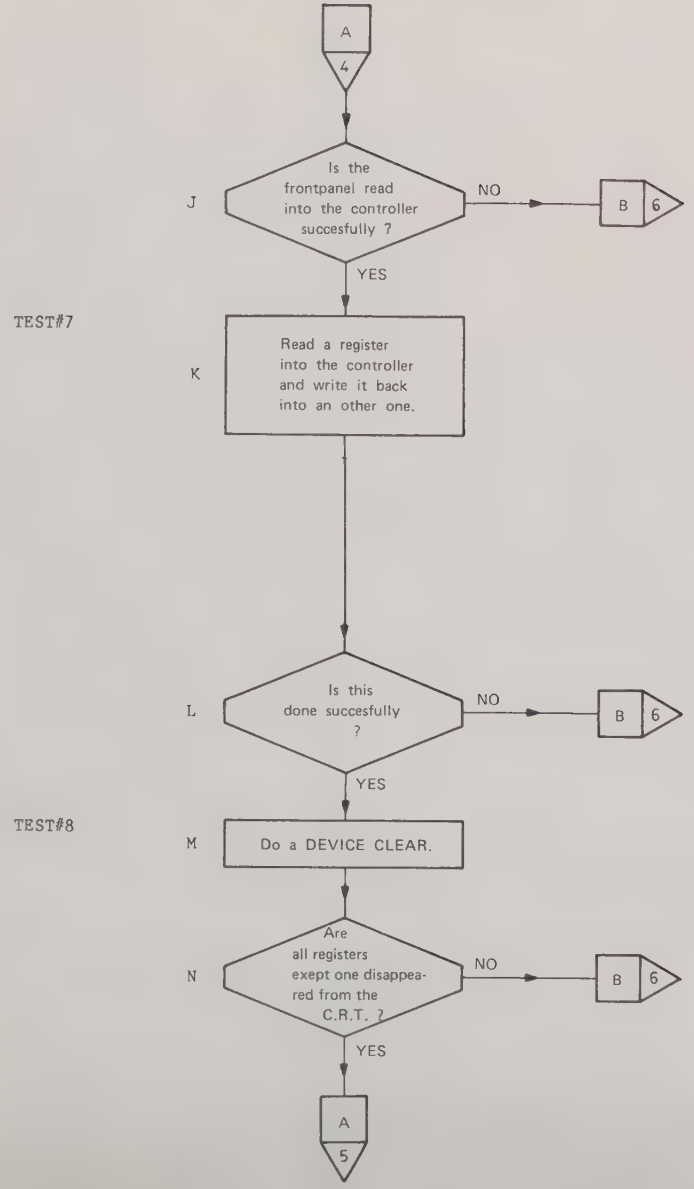
```
280 ! **TEST 1:
290 ! **CHECK IF INSTRUMENT GOES
     TO REMOTE
300 ! ** A
310 DISP "TEST 1:"
320 OUTPUT 708 USING "K" ; "RL11
    206B00501B1420003310"
```

```
330 ! **B
340 BEEP
350 DISP "IS REMOTELAMP ON? (Y O
    R N)";
360 GOSUB 1740
370 ! **TEST 2:
380 ! **CHECK THAT LED DISPLAYS
    ARE LOADED CORRECT
390 ! **C
400 DISP "TEST 2"
410 BEEP
420 DISP "CHECK ALPHANUMERIC DIS
    PLAYS:"
430 DISP "  YA: 20-3  YB: .5*"
440 DISP "  TB: 20-6  DT: 3310"
450 DISP " OK ( Y OR N )";
460 GOSUB 1740
```



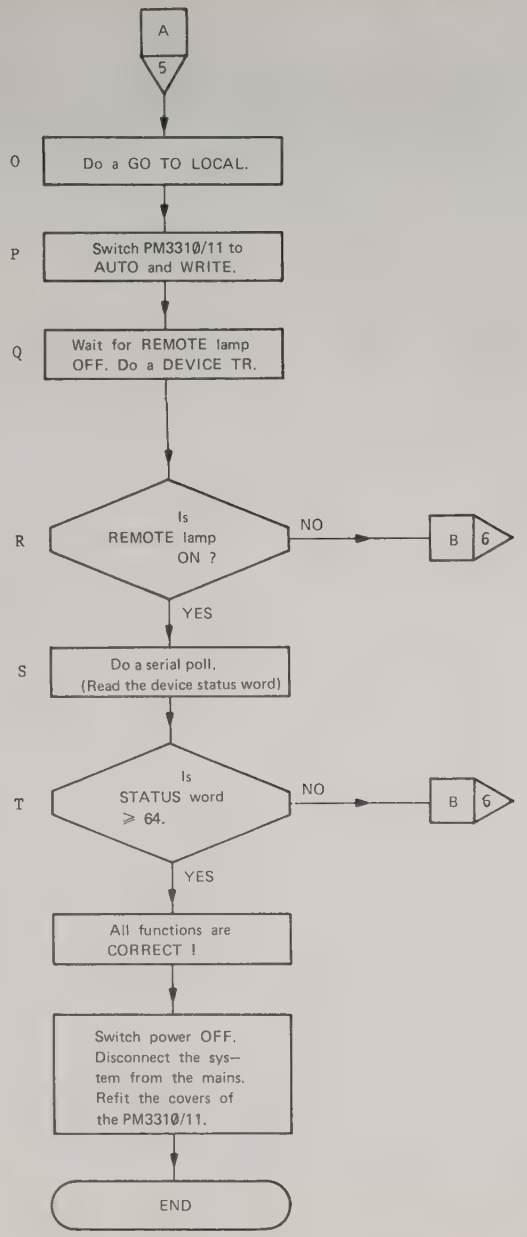
③

```
470 ! **TEST 3
480 ! **CHECK RESPONSE TO GO TO
    LOCAL
490 ! **D
500 DISP "TEST 3"
510 LOCAL 708
520 RESUME 7
530 BEEP
540 DISP "-TURN-ON ACCU, STO 2 A
    ND STO 3   MANUALLY"
550 DISP "-SELECT STO 1 FOR LED
    DISPLAY"
560 ! **E
570 DISP ""
580 DISP "IS REMOTE LED OFF ( Y
    OR N )";
590 GOSUB 1740
600 ! **TEST 4
610 ! **CHANGE DELIMITER
620 ! ** F
630 DISP " TEST 4"
640 WAIT 1000
650 CONTROL 7,16 ; 1,37
660 U$=E$&"0DD0"
670 OUTPUT 708 USING "K" ; U$
680 CLEAR
690 DISP " TEST 4 COMPLETE"
700 WAIT 2000
710 CLEAR
720 ! ** TEST 5
730 ! ** CHECK RESPONSE TO READ
    FRONTPANEL COMMAND
740 ! ** G
750 DISP " TEST 5"
760 Z$=E$&"0MT00"
770 OUTPUT 708 USING "K" ; Z$
780 ! ** H
790 BEEP
800 DISP "IS PM 3310 CRT DARK (
    Y OR N )"
810 GOSUB 1740
820 ! ** TEST 6
830 ! ** READ FRONT PANEL SETTIN
    GS AND CHECK ARRAY DISPLAYED
840 ! **I
850 DISP "TEST 6:"
860 FOR I=1 TO 25 STEP 2
870 ENTER 708 USING "#,3A" ; B$
880 F$[I]=B$[1,2]
890 NEXT I
900 DISP F$
```




```
910 ! ** J
920 BEEP
930 DISP " CHECK IF 26 CHARACTER
    S HAVE "
940 DISP " BEEN RECEIVED STARTIN
    G WITH MT"
950 DISP " OK ( Y OR N )";
960 GOSUB 1740
970 ! ** TEST 7
980 ! ** READ ACCU INTO HP 85 AN
    D THEN STORE CONTENTS INTO S
    TO 1 OF PM3310
990 ! ** K
1000 DISP "TEST 7:"
1010 DISP "ACCU IS NOW COPIED IN
     TO HP-85"
1020 DISP "AND LOADED BACK INTO
     PM3310,"
1030 DISP "USING STO 1."
1040 DISP ""
1050 Y$=E$&"0RK00"
1060 OUTPUT 708 USING "K" ; Y$
1070 FOR I=1 TO 535 STEP 2
1080 ENTER 708 USING "#,3A" ; B$
1090 R$[I]=B$[1,2]
1100 NEXT I
1110 OUTPUT 708 USING "K" ; "RL"
     ;R$[3,536]
1120 ! **L
1130 BEEP
1140 DISP " WAS REGISTER TRANSFE
     R SUCCESFUL"
1150 DISP " ( Y OR N )";
1160 GOSUB 1740
1170 ! ** TEST 8
1180 ! ** CHECK RESPONSE TO DEVI
     CE CLEAR
1190 ! ** M
1200 DISP "TEST 8:"
1210 CLEAR 708
1220 RESUME 7
1230 ! ** N
1240 BEEP
1250 DISP " HAVE AL REGISTERS BU
     T ONE DIS-  APPEARED FROM S
     CREEN"
1260 DISP " ( Y OR N )";
1270 GOSUB 1740
```

TEST#9

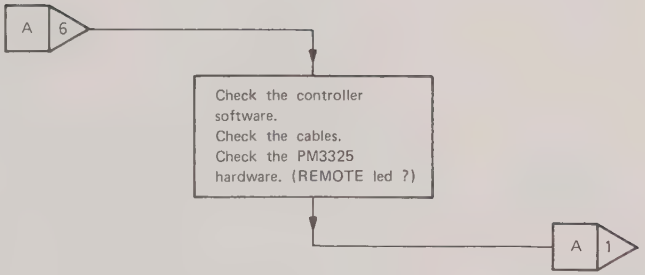


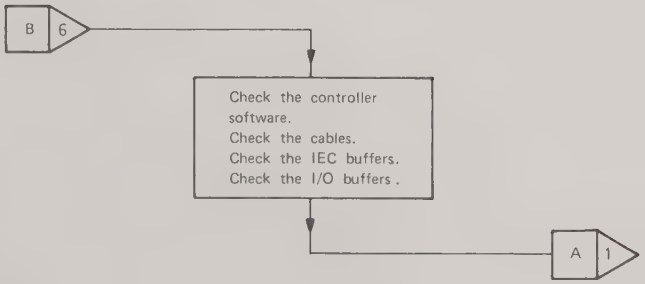
⑤

```
1280 ! **TEST 9
1290 ! **SETUP INSTRUMENT FOR TR
     IGGER COMMAND
1300 ! **CHECK RESPONSE TO DEVIC
     E TRIGGER
1310 ! **READ STATUS REGISTER AN
     D DISPLAY ON HP 85 SHOULD B
     E EQUAL TO OR GREATER THAN
     '64'
1320 ! ** 0
1330 DISP "TEST 9:"
1340 LOCAL 708
1350 RESUME 7
1360 ! **P
1370 BEEP
1380 DISP "SWITCH PM 3310 TO:-WR
     ITE"
1390 DISP "                    -AU
     TO"
1400 DISP "                    -RE
     CURRENT"
1410 DISP ""
1420 ! **Q
1430 DISP "IS REMOTELAMP OFF ( Y
      OR N )";
1440 GOSUB 1740
1450 TRIGGER 708
1460 RESUME 7
1470 ! **R
1480 DISP "TEST 9 CONT'D:"
1490 DISP ""
1500 BEEP
1510 DISP "IS REMOTE LED ON ? (
     Y OR N )"
1520 GOSUB 1740
1530 ON INTR 7 GOTO 1570
1540 ENABLE INTR 7;8
1550 GOTO 1530
1560 ! **S
1570 S=SPOLL(708)
1580 DISP "TEST 9 CONT'D:"
1590 DISP ""
1600 BEEP
1610 DISP "STATUSWORD =";S
1620 ! **T
1630 DISP "IS STATUSWORD >=64  (
      Y OR N )"
1640 GOSUB 1740
```

```
1650 ! **END OF TEST
1660 DISP ""
1670 DISP "TEST COMPLETE."
1680 DISP "","",""
1690 DISP "**********************
     **********"
1700 DISP "PRESS 'RUN', TO START
     "
1710 DISP "NEW SEQUENCE"
1720 RESET 7
1730 END
```

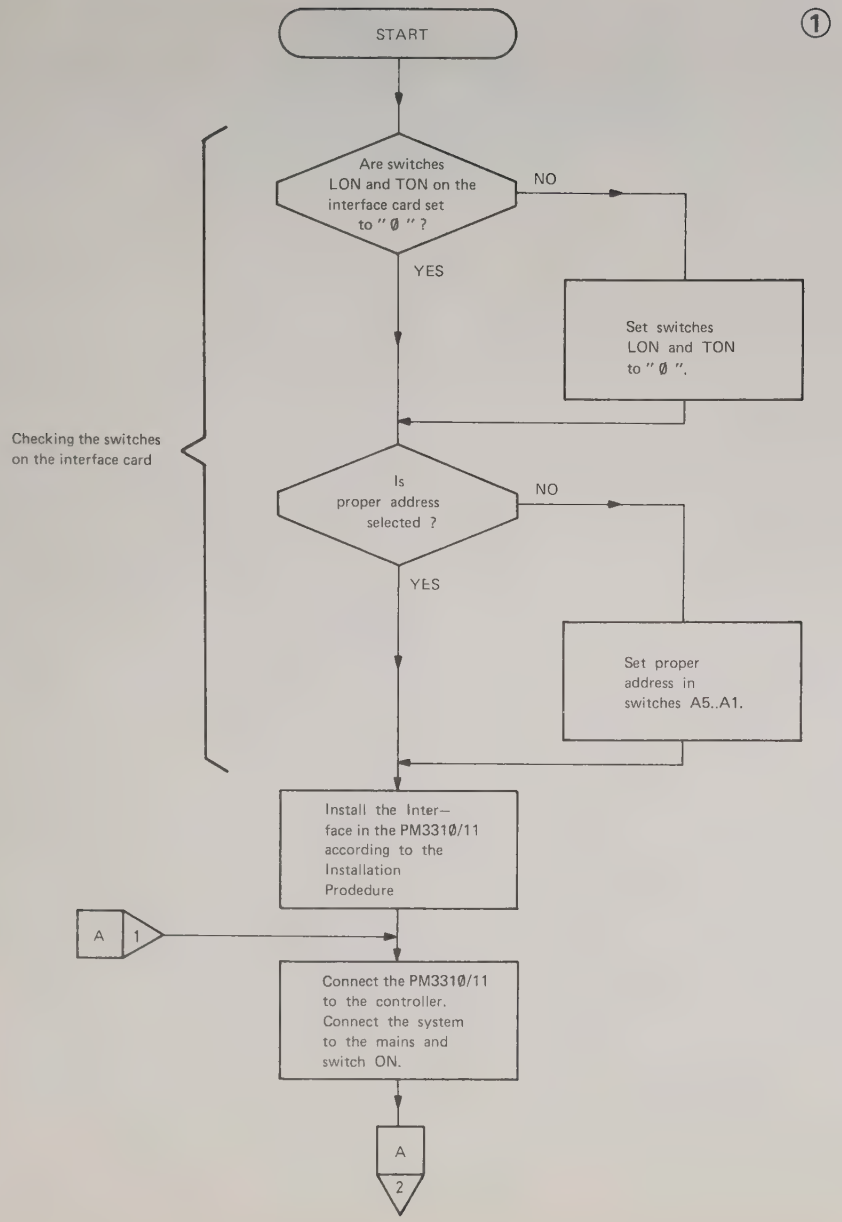
⑥






```
1740 ! **RESPONSE TO DISPLAY (HP
      85) QUESTIONS
1750 ! ** IF YES CONTINUE
1760 ! ** IF NO DETERMINE PROBLE
     M AND RESTART PROGRAM
1770 INPUT X$
1780 IF X$="N" THEN 1810
1790 CLEAR
1800 RETURN
1810 DISP "CORRECT ERRORCONDITIO
     N"
1820 DISP "PRESS RUN TO RESTART
     THIS FUNCTIONAL TEST AGAIN"
1830 STOP
1840 ! **TIME-OUT ROUTINE
1850 ! **IF THE IEEE BUS GETS HU
     NG UP IN MIDDLE OF EXCHANGE
1860 ! **A 3 SECONDS TIME-OUT WI
     LL RELEASE THE HP 85
1870 FOR I=1 TO 6
1880 STATUS 7,I ; S(I)
1890 DISP "STATUSBYTE #";I;"=";S
     (I)
1900 NEXT I
1910 RESET 7
1920 S=SPOLL(708)
```

```
1930 DISP "DEVICESTATUS =";D$
1940 GOTO 1810
1950 INPUT X$
1960 RETURN
1970 ! Modified 8/15/1982,PTMI,
      H.Toorens.
```

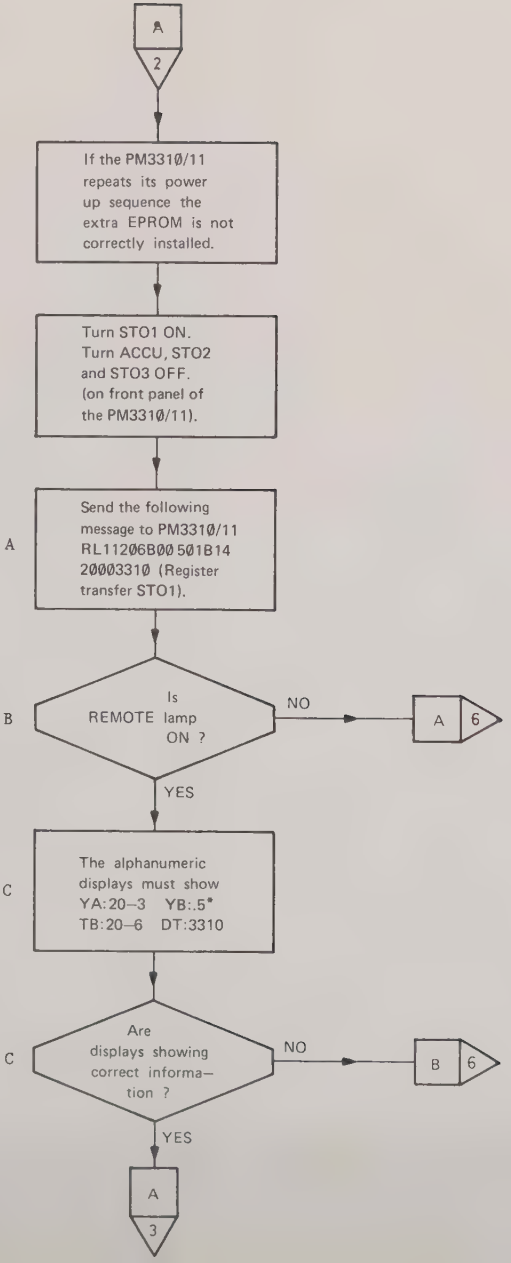

①
START
Are switches LON and TON on the interface card set to " Ø " ?
NO
YES
Set switches LON and TON to " Ø ".
Checking the switches on the interface card
Is proper address selected ?
NO
YES
Set proper address in switches A5..A1.
Install the Inter– face in the PM3310/11 according to the Installation Prodedure
A 1
Connect the PM3310/11 to the controller. Connect the system to the mains and switch ON.
A 2

CBM IEC-SOFTWARE

****FUNCTIONAL CHECK****

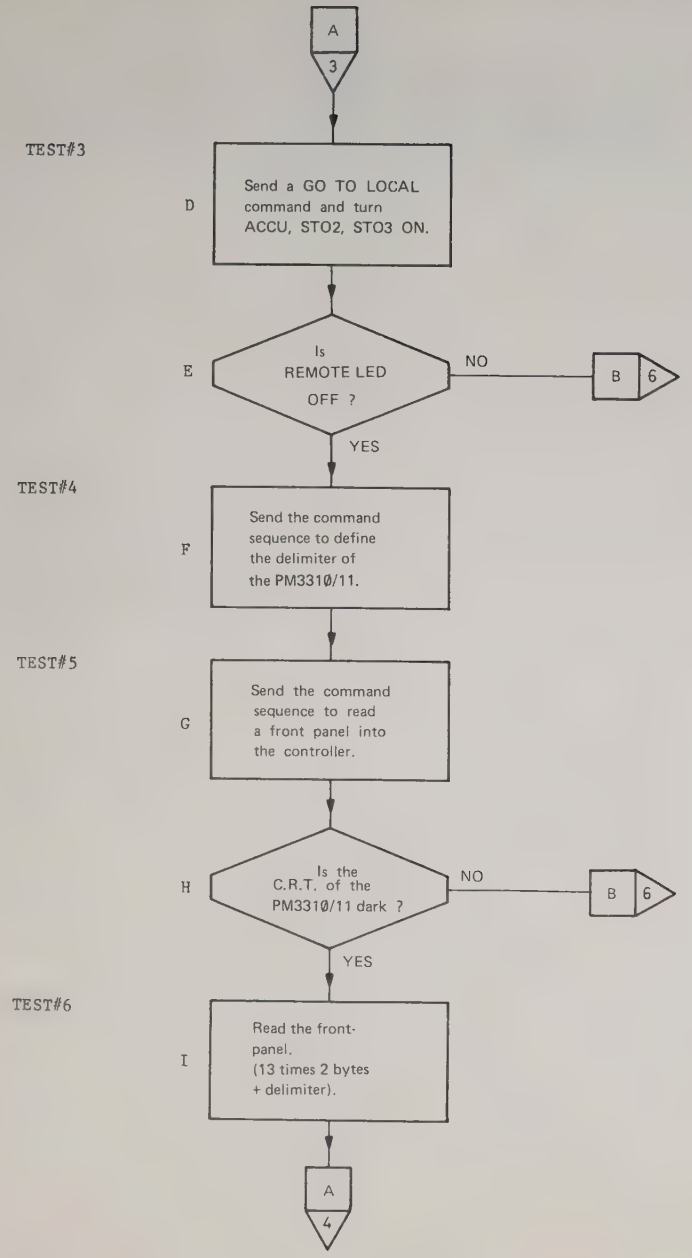
INITIALIZATION

```
10    PRINTCHR$(147)
100   A1=59426
110   A2=59427
120   A3=59456
130   A4=59425
140   A5=59424
150   DIM R(268,3)
160   DIM M$(30)
170   PRINT"FUNCTIONAL TEST"
180   PRINT"**************************,,
190   PRINT"  SET-UP INSTRUCTIONS:"
200   PRINT" –ASSURE THAT LON AND TON"
210   PRINT"  SWITCHES ON INTERFACE"
220   PRINT"  CARD ARE SET TO Ø."
230   PRINT" –SET ADDRESS SWITCHES TO 8."
240   PRINT" –ON PM 3310/11:"
250   PRINT"  TURN STO1 ON."
260   PRINT"  TURN ACCU, STO2 AND STO3"
270   PRINT"  OFF."
280   PRINT"PRESS 'R' WHEN READY TO"
290   PRINT'CONTINUE."
300   INPUT AS:IF A$="R" THEN 320
310   GOTO 280
```



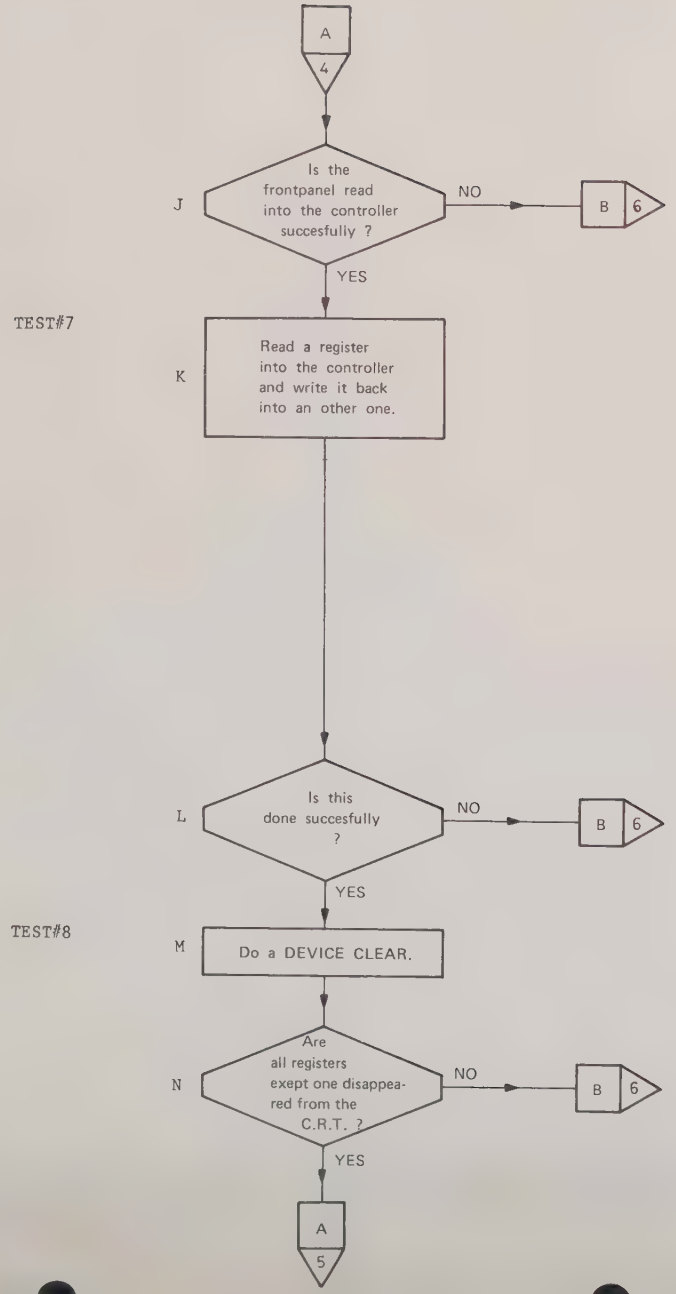
②

```
320  REM ** TEST # 1 :
330  REM ** CHECK IF INSTRUMENT GOES TO REMOTE

340  REM ** A
350  PRINTCHR$(147)
360  PRINT"TEST#1:"
370  OPEN3,8
380  PRINT#3, "RL11206B00501B1420003310"
390  CLOSE3

400  REM ** B
410  PRINT"IS REMOTE LED ON (Y OR N) ?";
420  GOSUB 8000

430  REM ** TEST # 2 :
440  REM ** CHECK THAT LED DISPLAYS ARE LOADED CORRECT

450  REM ** C
460  PRINTCHR$(147)
470  PRINT"TEST#2:"
480  PRINT"   CHECK ALPHANUMERIC DISPLAYS:"
490  PRINT"    YA: 20-3    YB: .5*"
500  PRINT"    TB : 20-6    DT: 3310"

510  PRINT"   OK (Y OR N) ?";
520  GOSUB 8000
```



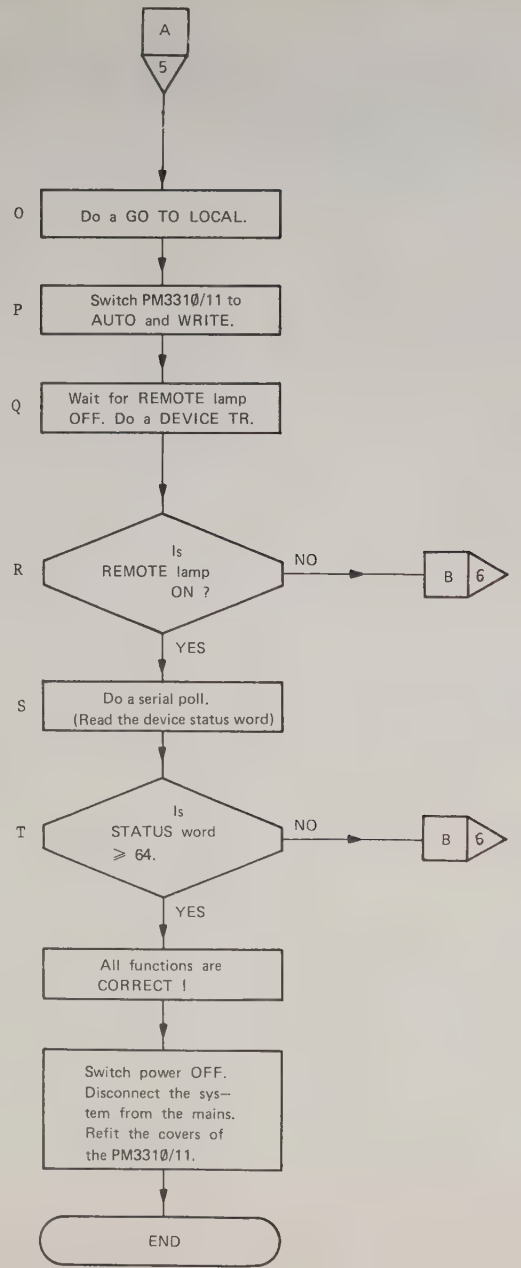
③

```
530  REM ** TEST # 3 :
540  REM ** CHECK RESPONSE TO GO TO LOCAL COMMAND

550  REM ** D
560  PRINTCHR$(147)
570  PRINT"TEST#:3"
580  C=1
590  GOSUB 5000
600  PRINT"  TURN ACCU, ST02 AND ST03 ON"
610  PRINT"  MANUALLY, SELECT ST01 FOR LED"
620  PRINT"  DISPLAY."

630  REM ** E
640  PRINT"  IS REMOTE LED OFF (Y OR N) ?";
650  GOSUB 8000

660  REM ** TEST # 4 :
670  REM ** CHANGE DELIMITER + WAIT TIME
680  PRINTCHR$(147)
690  PRINT"TEST#4:"

700  REM ** F
710  D$=CHR$(27) + "0DD0"
720  OPEN 3,8
730  PRINT#3,D$
740  CLOSE3
750  D$=CHR$(27) + "0DW15"
760  OPEN 3,8
770  PRINT#3,D$
780  CLOSE3

790  REM ** TEST # 5 :
800  REM ** CHECK RESPONSE TO READ FRONT PANEL COMMAND

810  REM ** G
820  PRINTCHR$(147)
830  PRINT"TEST#5:"
840  OPEN 3,8
850  D$=CHR$(27) + "0MT00"
860  PRINT#3,D$

870  REM ** H
880  PRINT"  IS PM 3310/11 C.R.T. DARK (Y OR N) ?";
890  GOSUB 8000

900  REM ** TEST # 6 :
905  REM ** READ FRONT PANEL SETTINGS AND CHECK ARRAY
910  REM ** DISPLAYED
920  PRINTCHR$(147)

930  REM ** I
940  PRINT"TEST#6:"
950  FOR I=1 TO 13
960  INPUT#3,A$
970  M$= M$ + A$
980  NEXT I
990  CLOSE3
995  PRINT"M$ = ";M$
```




```
1000  REM ** J
1010  PRINT"CHECK IF 13 GROUPS OF TWO BYTES ARE"
1015  PRINT"RECEIVED STARTING WITH 'MT'."
1020  PRINT"   OK (Y OR N) ?";
1030  GOSUB 8000

1040  REM ** TEST # 7 :
1050  REM ** READ ACCU INTO CBM AND THEN STORE INTO STO1
      IN PM 3310/11

1060  REM ** K
1070  PRINTCHR$(147)
1080  PRINT"TEST#7:"
1085  PRINT"ACCU IS COPIED NOW IN STO1"
1090  OPEN 3,8
1100  D$=CHR$(27) + "ØRKØØ"
1110  PRINT#3,D$
1120  FOR I=1 TO 268
1130  INPUT#3,A$
1140  R(I,1)=ASC(LEFT$(A$,1))
1150  R(I,2)=ASC(RIGHT$(A$,1))
1160  NEXT I
1170  CLOSE3
1180  OPEN 3,8
1190  D$="RL"
1200  PRINT#3,D$
1210  FOR I=2 TO 268
1220  D$=CHR$(R(I,1))+CHR$ (R(I,2))
1230  PRINT#3,D$
1240  NEXT I
1250  CLOSE3

1260  REM ** L
1270  PRINT"WAS REG. TRANSFER SUCCESSFUL (Y OR N) ?";
1280  GOSUB 8000

1290  REM ** TEST # 8 :
1300  REM ** CHECK RESPONSE TO DEVICE CLEAR COMMAND

1310  REM ** M
1320  PRINTCHR$(147)
1330  PRINT"TEST#8:"
1340  C=4 : GOSUB 5000

1350  REM ** N
1360  PRINT"HAVE ALL REGISTERS BUT ONE DISAPPEARED"
1370  PRINT"FROM SCREEN (Y OR N) ?";
1380  GOSUB 8000
```

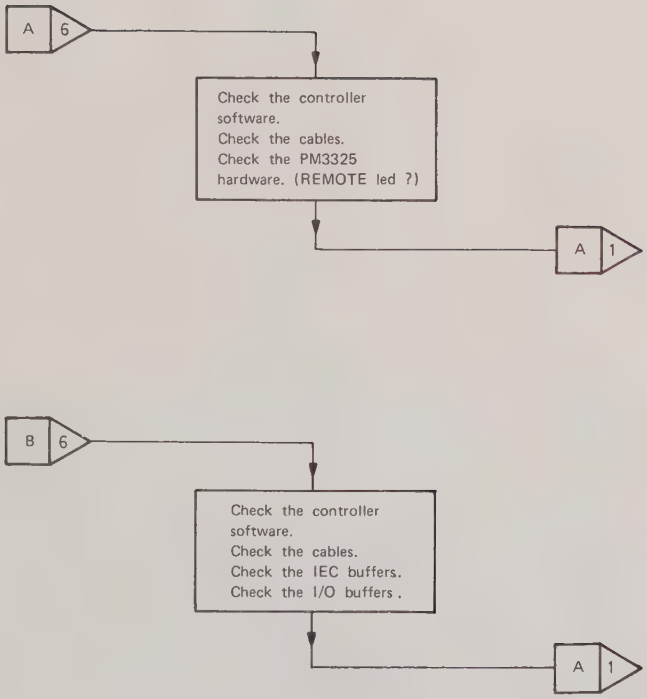
TEST#9



⑤

```
1390  REM ** TEST #9 :
1400  REM ** SET-UP INSTRUMENT FOR TRIGGER COMMAND
1410  REM ** CHECK RESPONSE TO DEVICE TRIGGER
1420  REM ** READ STATUS REGISTER AND DISPLAY ON
1430  REM ** CBM SHOULD BE >= '64'.

1440  REM ** 0
1450  PRINTCHR$(147)
1460  PRINT"TEST#9:"
1470  C=1 : GOSUB 5000

1480  REM ** P
1490  PRINT"SWITCH PM 3310/11 TO AUTO AND WRITE."
1500  PRINT"SWITCH PM3310/11 TO RECURRENT."

1510  REM ** Q
1520  PRINT"IS REMOTE LED OFF (Y OR N) ?";
1530  GOSUB 8000
1540  C=8 : GOSUB 5000

1550  REM ** R
1560  PRINT"IS REMOTE LED ON (Y OR N) ?";
1570  GOSUB 8000

1580  REM ** S
1590  C=72 : GOSUB 5000
1600  C=24 : GOSUB 5000
1610  GOSUB 6000
1620  C=25 : GOSUB 5000
1630  C=95 : GOSUB 5000
1640  PRINT"STATUS WORD = ";D

1650  REM ** T
1660  PRINT"IS STATUS WORD >= '64' (Y OR N) ?";
1670  GOSUB 8000

1680  REM ** END OF TEST :

1690  PRINTCHR$(147)
1700  PRINT" "
1710  FOR I=1 TO 100:NEXT I
1720  PRINT"TEST COMPLETE"
1730  FOR I=1 TO 100:NEXT I
1740  GOTO 1690
1750  END
```

⑥




```
5000  REM ** HANDSHAKE PROCEDURE FOR FUNCTIONS:
5001  REM ** GO TO LOCAL ---------- GTL
5002  REM ** DEVICE CLEAR ---------- SDC
5003  REM ** DEVICE TRIGGER ---------- GET
5004  REM ** SERIAL POLL ENABLE---------- SPE
5005  REM ** SERIAL POLL DISABLE ---------- SPD
5006  REM ** LISTENER ADDRESS ---------- LA
5007  REM ** TALKER ADDRESS ---------- TA
5008  REM ** UNTALK ---------- UNT

5010  REM GO TO LOCAL          GTL  C=1
5020  REM DEVICE CLEAR         SDC  C=4
5030  REM DEVICE TRIGGER       GET  C=8
5040  REM SERIAL POLL ENABLE   SPE  C=24
5050  REM SERIAL POLL DISABLE  SPD  C=25
5060  REM LISTENER ADDRESS           C=32 + 8
5070  REM TALKER ADDRESS             C=64 + 8
5080  REM UNTALK                     C=64 + 31
5090  REM *** C HAS TO BE DEFINED AT ENTRY
5095  REM          OF THIS SUBROUTINE! ***
5100  B=C : REM BACK-UP C
5110  C=40 : REM LISTENER ADDRESS PM 3310 (32+8)
5120  GOSUB 5200 : REM TALKER HANDSHAKE
5130  C=B : REM RESTORE C
5140  GOSUB 5200 : REM TALKER HANDSHAKE
5150  RETURN

5200  REM ** TALKER (SOURCE) HANDSHAKE **
5210  REM ** SET DATA-LINES (INVERSE OF C)
5220  POKE A1, (225-C)
5230  REM ** SET ATN-LINE TO 0
5240  POKE A3, PEEK(A3) AND (255-4)
5250  REM ** DO HANDSHAKE
5260  REM ** SET NDAC AND NRFD TO 1
5280  POKE A4, PEEK(A4) OR 8
5290  POKE A3, PEEK(A3) OR 2
5300  REM ** WAIT UNTILL NRFD IS 1 (FROM OTHER DEVICES)
5310  T=PEEK(A3) AND 64: IF T=0 THEN 5310
5320  REM ** SET DAV TO 0 (INDICATING DATA AVAILABLE)
5340  POKE A2, PEEK(A2) AND (255-8)
5350  REM ** WAIT UNTIL NDAC IS 1 (INDICATE DATA ACCEPTED)
5360  T=PEEK(A3) AND 1: IF T=0 THEN 5360
5370  REM ** SET DAV TO 1
5380  POKE A2, PEEK(A2) OR 8
5390  REM ** REMOVE DATA (NOT NECESSARY)
5400  POKE A1, 255
5410  REM ** REMOVE NDAC
5420  POKE A4, PEEK(A4) AND (255-8)
5430  REM ** SET ATN TO 1
5440  POKE A3, PEEK(A3) OR 4
5450  RETURN
```

```
6000  REM ** LISTENER (ACCEPTOR) HANDSHAKE **
6010  REM ** ENABLE NRFD
6020  POKE A3, PEEK(A3) OR 2
6030  REM ** WAIT FOR DAV Ø
6040  T=PEEK(A3) AND 128: IF T=1 THEN 6040
6050  REM ** SET NRFD TO Ø
6060  POKE A3, PEEK(A3) AND (255-2)
6070  REM ** WAIT FOR NRFD Ø
6080  T=PEEK(A3) AND 64: IF T=1 THEN 6080
6090  REM ** LOAD DATA IN D
6100  D=PEEK(A5)
6110  REM ** SET NDAC TO 1
6120  POKE A4, PEEK(A4) OR 8
6130  REM ** WAIT FOR DAV 1
6140  T=PEEK(A3)  AND 128: IF T=Ø THEN 6140
6150  REM ** NDAC Ø
6160  POKE A4, PEEK(A4) AND (255-8)
6170  RETURN

7999  STOP

8000  REM ** RESPONSE TO DISPLAY (CBM) QUESTIONS
8001  REM ** IF YES CONTINUE - IF NO DETERMINE
8002  REM ** PROBLEM AND CONTINUE TEST

8003  INPUT XS
8010  IF XS="N" THEN GO TO 8030
8020  RETURN
8030  PRINT "CORRECT ERROR CONDITION"
8040  PRINT "TYPE -RUN- AND PRESS RETURN"
8050  PRINT "TO START THIS FUNCTIONAL"
8060  PRINT "TEST AGAIN"
8070  STOP
```

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